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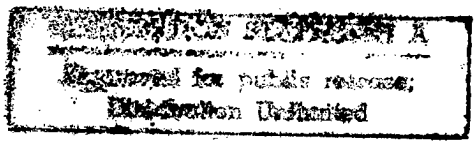

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Swiss Researchers Combine Fullerenes With Sugar Molecule

93WS0125D Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT 11 Nov 92 p 8

["Fullerene with Sugar Molecule"]

[Text] FRANKFURT—Swiss scientists have produced "sweet" fullerenes for the first time. Francois Diederich, Andrea Vasella, and colleagues have succeeded in bonding the C_{60} molecule with a reactive sugar derivative. In doing so, they at the same time produced a chiral fulleroid (a sort of "soccer ball" molecule with "anchor"), which can occur as image and mirror image.

The new sweet fullerenes are of considerable interest since an altered, perhaps, better solubility is expected after separation of the protective groups in the sugar. The remaining glucose attracts water, and the fullerene component repels water. The scientists hope that with this kind of bonding class it might be finally possible to study the biochemical and pharmacological potential of fullerenes. Previously, all hopes in this regard were purely speculative. The chemists replaced the hydroxyl groups in a glucose molecule with so-called protective groups. Then they activated the sugar to a diazirin unit, capable of reacting with carbon double bonds. The diazirin sugar was actually added to the double bonding in the fullerene.

Since the sugar molecules used consisted exclusively of an enantiomorphic sort, the scientists reported in the Zeitschrift Angewandte Chemie (No. 104, 1992, p. 1383) that this was also the first enantiomorphically pure fullerene derivative.

The researchers even have evidence that a multiple substitution had partially occurred. Mixtures of various strong substituted products have often appeared even in other reactions of fullerenes with activated particles. The 1:1-products can easily be separated from C_{60} that has not reacted by means of column chromatography.

AEROSPACE

Airbus's Beluga Transport Plane Described

93WS0064A Stuttgart FLUG REVUE in German Oct 92 pp 48-49

[Article by Volker Leuchsner under the rubric "Aerospace Magazine": "Successor to the Super Guppy: the Beluga Airbus; Big Door and a Lot Behind It"; first paragraph is an introduction]

[Text] Named after the Beluga white whale, a successor model for the Super Guppy is coming into being in France, by means of which components for Airbus planes will also in the future be able to come by air to the final assembly line. The Beluga is based on the A300.

The days are numbered at Airbus Industrie in which transport planes that are based on an almost 40-year-old technology help their high-tech great grandsons to become full-fledged. As of the summer of 1995 the four Super Guppies are to be replaced by new A300-600ST supertransports that will then carry to the final assembly line in Toulouse and Hamburg components made by the various European Airbus partners. Airbus Industrie has been forced to this measure because the maintenance expenses for the aging Super Guppy are becoming higher and higher. The fleet's transport capacity is also no longer sufficient for the big new planes and the large quantities.

The first contracts have now been awarded by SATIC [Special Aircraft Transport International Company] for the construction of the new transport, which is to be produced on the basis of the most up-to-date version of the A300-600R. The construction of the first parts is to begin this year. The first plane is scheduled for the end of 1994. SATIC is in charge of heading the program and is defining the design principles. Deutsche [German] Airbus and Aerospatiale each have a 50-percent share in the German-French joint venture with its headquarters in Toulouse.

Having the same impressive fuselage shape as the Super Guppy, the substantially larger A300-600ST, which by now has been given the nickname Beluga, will have a cockpit moved to the under-floor level and will be furnished with a front freight door that opens upward. With this arrangement loading times can be shortened from two to three hours to 45 minutes, because all the electrical connections and control connections no longer have to be broken.

At the same time the downward moved cockpit lowers the design expenses that would have been necessary in order to fulfill the safety specifications. If the cockpit were directly in front of the cargo, then the rear wall would have to be designed so that the cargo cannot break into the cockpit in the event of a crash, to deceleration of 6 G. So, the cargo simply slides over the pilots. All the same the cockpit is among the parts that cannot just be simply borrowed from the A300, because in the Beluga it is the only pressurized space in the airplane.

The fuselage puffed up to a diameter of 7.7 meters has a strong influence on the aerodynamics and aeromechanics of the A300-600ST. The Beluga is slightly sidewind sensitive at lower flight speeds. The bulky fuselage would cover the vertical tail surfaces with high angles of attack. Therefore the horizontal tail surfaces will be modified in order to achieve sufficient longitudinal stability. The vertical tail's effectiveness will be increased by means of two additional fins. In addition, the Beluga will get a new navigation system. The low-speed tests in the wind tunnel have also been successfully concluded in the meantime.

With regard to economic efficiency, the flying whale is far superior to its predecessor from the ornamental fish kingdom. Airbus Industrie is counting on the halving of transport costs. The thrust from two General Electric CF6-80C2A2 engines sees to it that the Airbus supertransport can transport all the components of a complete A340 from the manufacturing sites to Toulouse in only 19 hours of flying (54 hours for the Super Guppy). The maximum payload of 46 tons with a range of around 1570 kilometers is double as high, and the cruising speed, with a Mach number of 0.7, almost three times as high, as that of the Super Guppy.

Technical Data: Airbus Supertransport

Manufacturer: Special Aircraft Transport International Company (SATIC), Toulouse, France.

General Data:

Engines—two GE CF6-80C2A2.

Measurements:

span—44.84 m;

length—54.08 m;

diameter of upper fuselage—7.7 m.

Weight:

maximum take-off weight—150 t;

maximum payload—46 t.

Capacity:

cruising speed—700 km/h (378 knots);

range—1570 km (848 NM).

Design in Open Competition

Four airplanes have been definitely ordered by Airbus Industrie at present. The first A300 production airplane, that is to be modified, is already being looked out for. For Udo Drager, SATIC's chief executive, this airplane program is like no other. More than 80 percent of the work has been assigned. So nearly everything, with the exception of the final assembly in Toulouse-Colomiers, comes under open competition. The companies just received performance targets and have to develop the components themselves. Within the framework of these requests for bids the contract for building the cockpit section went to the four French companies Latecoere, Sogerma-Socea Rochefort, Hurel-Dubois and Socata. The Spanish CASA Airbus partner is building all the cylindrical fuselage parts and the additional vertical fins and is modifying its standard components from the A300 program.

The conical tail parts of the new upper fuselage structure are being manufactured by Deutsche Airbus's Elbe Aircraft Plant in Dresden. It is also reponsible for adaptation of the horizontal tail surfaces. Dornier in Friedrichshafen is in charge of developing the cargo door, which is then to be built by Hamble Aerostructures in England. If one does not count the work being done by companies belonging to DA [Deutsche Airbus], then the share of German firms in the Beluga is comparatively small at less than 10 percent. The reason for this is the low interest and the prices of the German aviation industry, Udo Drager said in an interview with FLUG REVUE.

Airbus Industrie has already transferred part of the shipments to the highway in order to be able to bridge the bottlenecks in transport capacity that will be able to occur until the time that the first Beluga is put into service. The use of a Russian Antonov An-124 is also being contemplated. However, only wings, and no fuselage parts, can be transported by means of this airplane. Based on today's programs, the demand can be covered by means of four new A300-600STs, even if it means that they fly on weekends, Drager believes. Beyond that, additional airplanes are to be built depending on internal requirements. There is already talk internally of a fifth and sixth airplane, they say.

World Demand for Around 30 Belugas

But other companies could also benefit from the enormous transport capacity of the Airbus supertransport. The Beluga could be used to transport every possible large-size piece of freight—satellites, rocket stages or new-generation engines like the GE90, for example. Military shipments are also imaginable. Drager even goes so far as to imagine that Airbus's competitors Boeing and McDonnell Douglas could also have use for the airplane. He estimates the world demand at probably not more than 30 Belugas. Fifteen to 20 would be a realistic figure. However, intensive marketing is being contemplated not until after the first flight. The first A300-600ST is to be introduced to the public at Aerosalon 1995 in Le Bourget.

How many copies of this limited edition will really be built will be revealed then. As an art object, its collector's value would definitely exceed the presently sought unit price of around DM100 million.

Columbus Space Station Platform Described

93WS0064B Stuttgart FLUG REVUE in German Oct 92 p 56

[Article by Goetz Wange under the rubric "Aerospace Magazine; Space Station": "Platform for Columbus"; first paragraph is an introduction]

[Text] The ESA [European Space Agency] has to economize further in the Columbus space station program. In spite of this, an external platform is to be installed in addition.

No further significant changes will be made in the configuration in the Columbus docked European space station module. Romano Barbera, the head of the Columbus Program office of the European Space Agency (ESA) announced this at the International Space Congress in Washington. As was to be learned from informed sources, all the same an attempt is to be made by the ESA council of ministers' conference in Spain to bring the costs of the program down once more by 10 to 15 percent.

Earlier slimming measures resulted in cutting a lock chamber in the laboratory by means of which experiments on a support would have been able to be exposed directly to the environmental conditions of space. A less expensive solution will replace this now: the External Viewing Platform (EVP). This platform is to be attached to the rear end of the Columbus laboratory. The utilization concept has not been completely established yet, but excellent working conditions for astronomical observation instruments result from this addition. However, overboard maneuvers by astronauts are necessary in order to exchange instruments.

When it is launched by means of the space shuttle, the European contribution to the Freedom international space station will weigh 17 tons, 4 tons of which fall to the share of scientific apparatus and specimens. It is in the plans to supplement the laboratory so that a mass of up to 23 tons could be reached in the final development stage.

At present Columbus is slated in the Freedom station's assembly plan for the 13th flight in September 1998. "However, today it looks more likely that we will have our turn not until the middle of 1999," ESA manager Barbera commented.

The preparation program for utilization of the Columbus laboratory was shortened for cost reasons. There was originally talk of two flights with the Eureca platform and one manned mission in a shuttle/Spacelab mission in the period between 1995 and 1998. Now ESA will limit itself to one Eureca and Spacelab flight each.

Cooperation with the Russians is to be increased instead. Three missions to the Mir space station with ESA's taking part are to be carried out between 1994 and 1997. ESA is attaching importance to long-term stays in the second and third missions. "We are thinking of several weeks or even months," Barbera said, giving a glimpse of the current negotiations. Foreign astronauts have thus far been aboard for only one week at a time.

ESA has obviously shelved until later future plans for an independent permanently manned European space station. Cooperation with Russia is receiving priority. To begin with they want first to join in the work on Mir-2, the new configuration of the Russian space base aimed at for 1996-97. Then there could be a station designed jointly by the ESA and Russia that is open for other countries too.

Germany: MTU's Shrouded Propfan Engine Viewed

93WS0064C Stuttgart FLUG REVUE in German Oct 92 pp 74-77

[Article by Heinrich Hemker: "Clothes Make the Man; the Propfan Idea Will Be Presentable Because of a Jacket"; first paragraph is an introduction]

[Text] Progress is a snail. One thinks of this expression if one considers the history of the development of the propfan. The new engine system, by means of which the economic advantages of the propeller were to be passed on to transports, was not accepted by the airlines. The industry is trying to improve the efficiency of civilian engines in a less radical move by means of a shroud for the propfan.

Every sign points to growth: In spite of the airlines' current wretched state of affairs, every forecast proceeds on the assumption of doubling of the traffic volume by the year 2005. Therefore, new engines will be absolutely necessary, with once again reduced fuel consumption and lower pollution of the environment by the emission of noise and pollutants.

This goal can be attained only by the improvement of propulsion efficiency. The efficiency of a jet engine increases with the bypass ratio. This is how one characterizes the ratio of the cold air accelerated through the engine to the portion that is used in the propulsion system for combustion. The outside diameter of the fan has to be increased with a given thrust power in order to raise this index known as the bypass ratio. One can consider the rotor of a helicopter as an extreme example: Extremely high thrust powers, that act as the lift here, however, are produced with relatively low output with a bypass ratio far beyond 100.

Unshrouded propfans were the most logical implementation of this idea. However, because the airlines did not see any pressure to use this technology because of the fuel's price level, engine manufacturers sought a compromise between the conventional turbofan and the propfan. MTU [Motoren- und Turbinen-Union GmbH (Engine and Turbine Union Limited Liability Company)] in Munich, in conjunction with U.S. engine manufacturer Pratt & Whitney, studied a great number of possible configurations. In the process the shrouded propfan emerged as an optimal synthesis of the turbofan and propfan ideas. It promised to unite the advantages of the open propfan as regards fuel consumption with the installation-technique and operational advantages of modern turbofan engines.

Two designs were finally chosen and studied more closely. MTU chose the system designated CRISP [Counter Rotating Integrated Shrouded Propfan], while Pratt & Whitney developed the ADP [Advanced Ducted Prop]. The basic configurations are the same: The CRISP and ADP use modern lightweight-construction large-diameter fan blades in a short low-resistance

nacelle. Both work with a reducing gear between the slow-running fan and the fast-running low-pressure turbine. Both use a low-pollution combustion chamber. Both utilize variable-pitch fan blades that enable optimal adaptation to various flying conditions and make a thrust reversal system unnecessary. The most important difference: The ADP works with a single-stage propeller, while two counterrotating fans are used in the CRISP.

Various consequences result from this. The ADP has a simpler design, somewhat lower weight and lower costs—both in manufacture and in maintenance—than the CRISP, because the second fan stage and the gears for the reversal of rotation become unnecessary. The CRISP's advantage: The angular momentum produced by the first stage is practically compensated by the second fan stage. Accordingly, angular momentum loss does not occur, so that one can expect that the CRISP's efficiency is several percentage points better than that of the ADP. This is so by computation. However, Graduate Engineer Jost Schmidt, chief executive of MTU's Munich and Friedrichshafen companies, in charge of organizational unit development and marketing in Munich, still does not want to commit himself to an exact value: "We expect to achieve with the CRISP's one-meter rig efficiency just under three percent better than with the ADP. Accordingly, the CRISP is the optimal propulsion system especially for long-range airplanes. However, should it be found in tests that the CRISP's performance advantage comes to less than 2 percent, the additional technical expense would not be worth it."

The first step on the road to experimental verification of the CRISP design was the construction of a wind tunnel model having a fan diameter of 40 centimeters. The model consists of two counterrotating propfans, the pitch of whose blades can be adjusted when the turbine stops. A hot-air turbine rotates the fans via a gear unit. At a rotational speed of 12,000 revolutions per minute the model's rate of air flow comes to 25 kg/s and the absorbed power is close to 534 kW.

The tests conducted in various wind tunnels served primarily to gain knowledge concerning behavior with regard to aerodynamics and acoustics. An engine of the magnitude aimed at cannot be considered in isolation. Its integration into the airplane's aerodynamics must be taken into consideration already in the run-up. The take-off, cruising, landing and thrust reversal operating points and also engine failure under various conditions were analyzed here.

The acoustics are a particular problem. The measurements for this took place in the German-Dutch Wind Tunnel (DNW), which has proved itself to be excellent for acoustical tests. The CRISP model, which can be moved on three axes, was studied for its emission properties by means of a row of microphones consisting of nine elements. In addition to the fly-over noise with various output settings and air-flow angles, the model's internal noise was also measured, in order to obtain information for the acoustic lining of the CRISP.

ADP Demonstrator Under Testing

The next big step in the CRISP technology program is the construction of a one-meter model for tests in the DNW. More precise measurements of aerodynamic and acoustic behavior will be possible with this model. A larger model is especially necessary because here it is possible to adjust the blades during operation as in the jumbo engine. Investigations of nonstationary behavior will be possible for the first time in this way. Besides, the one-meter rig makes it possible to test and verify the types of construction required in the jumbo engine. This has already taken place for an especially critical component, i.e., the fan blades made of carbon-fiber-reinforced plastic. (See below.)

The expense of a one-meter rig is enormous. The cost is estimated at approximately 100 million German marks [DM]. Two type T64 helicopter engines, that have to work outside the experiment chamber, are intended for rotating the fans—3400 kW of power will be required. However, the first runs of the one-meter model are scheduled for 1993.

Perhaps too late for the CRISP design. For the ADP demonstrator has already been completed. The ground tests on the anechoic test bed in West Palm Beach, Florida, will have begun when this FLUG REVUE is delivered. The gas generator of this demonstrator is based on the PW2000 core engine. The demonstrator is to deliver approximately 50,000 pounds of thrust. The engine has a bypass ratio of 14:1. The three-meter-diameter fan is equipped with 18 blades. They were made by Hamilton Standard from a titanium-core carbon-fiber-reinforced plastic. The same company is also responsible for the blade angle setting system, which makes a thrust reversal system unnecessary. The blade adjustment is controlled by an FADEC [Full Authority Digital Engine Control] digital engine control system that Pratt & Whitney is using on all new-generation engines.

After the tests in Florida, the ADP demonstrator will be brought to the low-speed wind tunnel at NASA'S Moffet Field research center in California. Integration of the engine will also be studied there in addition to the aerodynamics and acoustics. They would also be happy with MTU if the ADP would decide the race for itself. They are also taking part in this program as Pratt & Whitney's partner. The designing and building of the low-pressure turbine took place at MTU. And they would certainly be welcome as a partner if a production decision is made, because, says Jost Schmidt, "No manufacturer yet wants to carry out a program alone today."

MTU Developing Carbon-Fiber-Reinforced Fan Blades

The development of the adjustable blades of the CRISP drive coupling was realized at MTU in Munich within

the framework of a technology program for lightweight-construction blades. The requirements for the blades are considerable: With a fan diameter of one meter 3400 kW are absorbed in both CRISP stages. The centrifugal force that occurs comes to 4.1 kN at the rated rotational speed. The construction principle was transferred from the large blades to the model size. Extremely lightweight construction was required. The blades have a hybrid-construction design with a titanium shank and CFRP [carbon-fiber-reinforced plastic] blades. The latter are fabricated from 70 different layers of a unidirectional CFRP prepreg which are cured in a CFRP mold in an autoclave. The blade root profile is mounted in the titanium shank by erosion (electrochemical). Then the blades are cemented to the titanium shank and riveted (with steel rivets). The connection is designed so that both cementing and riveting alone are able to transmit the forces that occur. The strength reserve created in this way is necessary because the aerodynamic phenomena that occur when the blade is adjusted, especially when the thrust is reversed, can still not be simulated.

New Hypersonic Thrust Nozzle Test Stand Described

93WS0064D Stuttgart FLUG REVUE in German Oct 92 p 80

[Article by Heinrich Hemker under the rubric "Technology Magazine": "Hypersonic Research; Thrust Nozzle Test Stand for DLR"; first paragraph is an introduction]

[Text] The German Research Institute for Aerospace (DLR) has put into operation a modern test stand for hypersonic propulsion systems.

Basic development in various fields of technology is an indispensable prerequisite for the realization of a project aiming so far into the future as that of the Saenger two-stage space transport. One of the space transport's big problem areas is the propulsion technology.

In the master design for the Saenger the propulsion system for the lower stage is designed as an air-breathing engine that works as a ramjet engine in the region of higher speeds. In such an engine the precompression required for combustion is produced by ramming the oncoming air. This air gets hot, the fuel is injected—hydrogen in this case—and the thermal energy is converted to thrust in the expanding nozzle.

The Saenger's ramjet engine is equipped with a variable-geometry nozzle in order to deliver the thrust required in the operative range of the lower stage—from launching to stage separation. It is precisely this nozzle that is the new test stand's subject of investigation. In terms of its design it is unique in Europe, because ramjet engines have thus far not been required for the high flight speed region aimed at.

The thrust nozzle test stand is to simulate the flight conditions as realistically as possible in the model experiment, i.e., the combustion chamber pressure, combustion temperature and nozzle reaction pressure. The test stand installed at DLR's Institute for Propulsion System Engineering at the Cologne-Porz research center at a cost of 10 million German marks [DM] also logically renders possible the investigation of regions that have thus far been inaccessible. Speeds of up to Mach 7 and the simulation of an altitude of up to 25 kilometers are possible. Thrust, lift and moment are measured continuously. The flow field inside the nozzle is made accessible for analysis by means of a special laser system. The experiment is controlled electronically and data acquisition and processing take place by means of a PC or mainframe computer.

Developable for Scramjet Tests

However, the field of activity is still not exhausted by the investigation of hypersonic propulsion systems. Because of the use of hydrogen as the fuel, the test stand is also suited for comprehensive investigations of hydrogen technology. The reduction of carbon dioxide production, combustion chamber design and studies of materials and construction methods for components subjected to high thermal stress are possible with the new DLR apparatus. Furthermore it is in the plans to investigate in a further development phase the scramjet technology, i.e., the technology of supersonic combustion.

DASA's Schrempp on Cooperation With Russians

93WS0104A Duesseldorf HANDELSBLATT in German 10 Nov 92 p 15

[Article by Jens P. Dorner: "Help Against Rivals from the U.S.A. and Japan"]

[Text]

DASA/Grand Plans With Russian Space Partners—Strict Orientation Toward Commercialization

Juergen E. Schrempp likes plain language. The chairman of the board of the Daimler-Benz subsidiary Deutsche Aerospace AG (DASA) does not believe the idle talk of western company representatives who outwardly want to help Russia and merely earn money as a side effect. During his most recent trip to the chaotic country, the man responsible for 80,000 employees and 18 billion German marks [DM] annual revenue had "very egotistical technological reasons" to advance. He wants to secure the best items from the Soviet space program for Europe's competition with American and Japanese economic competitors.

Whether the adventure will succeed is still uncertain for now. However, the fact that Schrempp's negotiation style ("I do not believe in steam-powered speeches.") was well received in Russia was crystal clear for his delegation. Afterward, the 48-year-old DASA manager returned to Germany certain he was holding a good hand

in the international poker game for the Soviet estate. "In the end, the Russians will go with the partner who provides them with the most."

Beforehand, Deutsche Aerospace brought them some bitter knowledge. Schrempp said, "Top technical performance was achieved using economic nonsense." In his opinion, only permanently new company foundings with European partners can save the radically downsized core of Moscow's space industry into the next millennium, not total vertical manufacturing (doing everything themselves). He sees Russia's future role no longer as a superpower in space but rather as a participant in joint projects with a dozen European countries. The Kremlin's percentage in the total European space concept would swing "between 15 and 25."

For the time being, however, money must be invested in the new partners. Thresholds for financial commitment in the east are DM80 billion from Germany and DM230 billion from the entire Western Europe. Schrempp hopes to compensate for the fact that this involves a joint venture in great jeopardy during politically unstable times by using "multidimensional" contracts and agreements on all levels. The DASA manager told the press in Moscow that this risk is offset by the real chance of survival over the long term against American and Japanese competitors by using Russian technology in the civilian "Star Wars."

The basis is a new joint-venture agreement with the Committee for the Defense Industry. This committee is only a few weeks old and is replacing all former Soviet structures in the largest country of the CIS and is consolidating future plans. Contacts with the Moscow company NPO Energiya are to be retained and expanded. This company is a potential technical partner in joint programs with the European Space Agency (ESA).

Until now, only statements of purpose regarding the joint space suit, a space taxi, or a new communications system are circulating between Russian and western European science centers. However, the Russian partners, according to Schrempp's idea, should completely conform to his European course by next spring at the latest. This is when the first intermediate result of the collective study for real joint ventures will be available.

The next ambassadors from DASA are already active in Moscow. Aviation specialists are talking shop with Russian experts about a 600- to 800-seat jumbo aircraft and about new propulsion systems. A conversion program for civilian aircraft is creating particular excitement. Aeroflot machines may no longer land in the west because of noise protection.

On the other hand, Schrempp is thinking out loud about Russian participation in the Jaeger 90, which he sees taking off unchanged. Perhaps the pilots will come down using a Russian ejection seat. In this area, Schrempp has a particularly high opinion of the ex-Soviet technology lead over Western Europe.

France: CNES Conducting Microgravity Experiments

93WS0118A Paris AFP SCIENCES in French 29 Oct 92 pp 15-16

[Unattributed article: "Two French Missions for the CNES [National Center for Space Studies] Zero-Gravity Caravelle"]

[Text] Paris—On 28 and 29 October, from the Marseille-Marignane airport, the CNES zero-gravity Caravelle completed two parabolic flight missions involving seven microgravity experiments designed by public and private laboratories in the Provence-Alpes-Cote d'Azur region.

These two demonstration flights were proposed by the regional council; their purpose was to show to manufacturers and researchers the interest of affordable and easily obtainable microgravity experiments, as made possible by the zero-gravity Caravelle. Twelve parabolas or so adding up to four minutes of microgravity time were completed during each flight, the Novespace company, a CNES subsidiary, indicated.

The condensed matter physics laboratory of the Nice University made an experiment on the self-organization of magnetic spheres in a magnetic field. The sensorimotor and behavioral adaptation and integration laboratory of the Saint-Jerome-Marseille faculty studied sensorimotor adaptations and the vibrational stimulation of muscle tendons.

The functional neurosciences laboratory of the CNRS [National Center for Scientific Research] (Luminy-Marseille campus) studied the effect of microgravity on axial synergism, while the Aix-en-Provence Regional Center for Popular and Sports Education (CREPS) studied muscular exercise as a means of prophylaxis during space missions.

In addition, the CNRS Research Center on Crystal Growth Mechanisms (CRMC2) studied the effects of microgravity on mercuric diodide, and the Unit for Training and Research in the Sciences and Techniques of Physical and Sports Activities (UFRStaps) performed motor coordination microgravity tests. Finally, the Cannes Space Camp took advantage of the flights to make an educational film on the laws of physics. As for Novespace, it studied the effects of microgravity on the digestive transit jointly with the Chamonix biohypoxia center.

The December agenda of the Caravelle will include a Japanese experiment on fluid physics. This year, the Caravelle will thus have been used for more than 45 parabolic flight experiments, for the CNES and the ESA [European Space Agency] respectively, in preparation for the future space missions of French and European astronauts.

International Research Program for Super- and Hypersonic Planes Described

93WS0188A Paris LE FIGARO in French
21 Dec 92 p 12

[Article by Jean-Paul Croize: "Acceleration of the Future Supersonic Program"; first paragraph is LE FIGARO introduction]

[Text] The Concorde will survive only a few years into the 21st century and its successor, on which all the world's big aircraft makers are collaborating, is still at the project stage. Research funds will be made available.

Preparing the "airplane of the future" is one of the major goals of research Prime Minister Pierre Beregovoy told his audience during the annual luncheon of the National Association for Technology Research (ANRT). "Jean-Louis Bianco is drafting a program for civil aeronautics research that will enable us to start preparing the airplane of the future within the next few years," said Mr. Beregovoy. Close collaborators of the prime minister and those who translate the cryptic utterances of Matignon take this to mean that the government wants to give a legal and financial framework to studies to develop the successors of current Airbuses and of the Concorde 10 or 15 years from now. These craft will serve until hypersonic planes—about which engineers are skeptical, at least for the near future—come on line.

"Such a program should make it possible to multiply the funding for research on these next generations of planes, which will be in the air 10 to 20 years from now, by a factor of at least 10," says Roger Pages, mission specialist at ANRT. Mr. Pages points out that big technology programs, which are generally cofinanced by the Ministry of Research and Space and the manufacturers involved, aim to "target" certain priorities in applied research. After the surge in biotechnologies, the improvement of highway safety, and the development of new electronic components, among other examples, the government is now making the development of technologies to improve air transport a priority. Henceforth, it is expected to appropriate funding on the order of a billion French francs [Fr] a year to research on aviation technologies.

Fuel Savings

"The focus is not on technologies for very-high-speed craft that may some day make the Asian continent a three-hour trip from Paris. Our much more concrete goal is to develop ways to make tomorrow's aircraft more reliable and efficient," explains Andre Dubresson, the director of civil aeronautics programs at the General Directorate of Civil Aviation.

The announced technology program should finance several lines of research, including studies on engines, the structure of future planes, and ground communication devices for aircraft. "The development of integrated-flow reactors, for instance, is expected to result in fuel savings of 30 to 40 percent and make engines significantly less polluting at the same time," stresses Andre Dubresson in particular. Likewise, the overall safety of civil aeronautics should be bolstered by the development of new systems linking planes in flight with the ground. The systems will shore up the ability of air traffic controllers to both monitor and guide aircraft.

The most "futuristic" aspect of the research in this program will involve the development of a possible successor to the Concorde, dubbed the ATSF [Future Supersonic Transport Plane]. Indeed, the ATSF project has reached the final stages of its "predevelopment," which was carried out by eight specialized manufacturers, including Aerospatiale for France.

The manufacturers include, notably, the American firms Boeing and McDonnell Douglas, and British, German, Italian, and even Russian aircraft makers. Experts estimate that if the international group manages to agree on the approximately Fr30 billion deemed necessary to truly launch the ATSF program, the project could get underway in 1995. This is a buffer date, beyond which there would be little hope of seeing such an airplane fly by 2005, which is when it will become imperative to retire the last Concordes. The prototype for the Concorde made its maiden flight in 1969.

Heat Resistance

The successor to the current Franco-British supersonic plane, whose design has already been largely decided upon, will not fly any faster than the original since it cannot exceed Mach 2.02. Its primary innovations were made possible by a new propulsion system and improved aerodynamics, and will include a flight range of 12,000 km instead of the current Concorde's 6,300, and a carrying capacity of 250 passengers instead of 100. Besides propulsion, the area of greatest concern to engineers is "materials." As the Concorde ages, it becomes apparent how much repeated temperature variations in the outside of the plane over the course of many flights degrades the airframe's strength through flight friction. The ATSF will require different materials, which are capable of withstanding for longer periods of time the 120 to 150 degrees reached in some sections of the airframe and wing unit during supersonic flight. They will, in fact, have to hold up for six hours instead of three.

Even more ambitious technologically, and even less certain financially, is the development of a so-called "hypersonic" plane that would fly at Mach 4 or 5. Engineers who expect to see one before 2040 or 2050 are rare. And any such plane will probably be nothing more than the spinoff of a futuristic space transport system—the "rocket plane"—which will be capable of flying both in the air and space through the mastery, as one might suspect, of several extremely complex technologies. "There are considerable problems to be overcome in this area," explains Gerard Larouelle, who is in charge of the "Hypersonic" sector at Aerospatiale. The company's

hypersonic studies are grouped under the "STS 2000" project. For Mr. Larouelle, the "main sticking point" of such a project is the propulsion system, which will have to be based on a "scramjet," an engine that combines both ramjet and rocket motor technology.

Yet here too, an initial big technology program called "Research Program on Hypersonic Advanced Propulsion" (Prephal) was launched in 1991. The Defense Ministry will appropriate Fr500 million over four years to the program, and the Research and Space ministry will provide Fr400 million. The remainder will be underwritten by the manufacturers involved in the work.

Future of French Military Space Program Discussed

93WS0188B Paris LE FIGARO in French 24 Dec 92 p 12

[Article by Jean-Paul Croize: "A Space Fleet for France's Defense"; first paragraph is LE FIGARO introduction]

[Text] Between now and the end of the century, our country will shore up its network with spy satellites that use sophisticated radar to make out ground details one meter in size—three meters in any type of weather—and that can intercept all the communications on the planet.

With Helios, Zenon, Osiris, and Syracuse, France—and with it a portion of Europe—will finally have a substantial space fleet worthy of the ones operated by the United States and Russia. "We must intensify the synergies between civil and military space research," recently declared prime minister Pierre Beregovoy. Mr. Beregovoy assigned Rene Pellat, the new head of France's space agency, the CNES, to come up with a plan for stepping up the agency's role in developing space military programs by next January. "Next year will be a great diplomatic year for space: During it the government should determine the ties between the CNES and military programs," contended Hubert Curien, minister of research and space.

The remarks of both men confirmed the ambitious plans—at least in the area of spy satellites—of the military appropriations bill presented by defense minister Pierre Joxe two months ago. Funding to construct the French satellites should increase by over 17 percent this year, and the program is expected to cost about 8 billion French francs [Fr] a year into the next century.

Indeed, in less than 15 months, France should have not only traditional picture-taking satellites, but radar satellites that can see what is happening on the ground through the densest clouds, and electronic "listening" satellites that will be able to pick up ground radio communications and detect waves from the "quietest" radar.

The program will require a total investment of nearly Fr50 billion. The first step will be to build the Helios surveillance system, with Matra Marconi Space (MMS) acting as chief architect.

France's Spot civil observation satellites will be used as a starting point for the system, and will be equipped with an extremely powerful telescope made by Aerospatiale despite its classification by the military as "top secret." The telescope can apparently make out ground details as small as one meter.

"Private" Communications

The first phase of Helios, which has a budget of Fr8 billion, will involve the construction of two satellites. The Italians and the Spanish are participating technically and financially, underwriting 15 and 7 percent of the cost respectively. The first satellite will be launched by Europe's Ariane rocket in 1994, while current plans call for keeping the second on the ground until 1997. At the request of the Defense Ministry, however, manufacturers are studying the possibility of placing the second one into orbit as early as 1996. This will enable France to overfly the globe at least once every 24 hours and thus to have a "tactical" system, that is, one that can be used in real time during a conflict.

Already the Defense Ministry is contemplating the construction of a second-generation of Helioses, whose development would also cost about Fr8 billion. The "Helios IIs" would be made before the end of the century and would have an even more efficient picture-taking system than the previous ones. In particular, they would employ infrared sensors, preliminary studies for which have begun at Aerospatiale.

But before they are put into service, the first Zenons, whose initial design phase has just been awarded to the Alcatel group, should make their appearance around 1997-98. The Zenons will be a family of light satellites, which will weigh a few hundred kilos compared to over 2 metric tons for the Helioses. Manufactured independently by France, they will reportedly cost about Fr3 billion.

Intelligence specialists consider the operation of these light satellites—which will probably number two—fundamental. The Zenons will enable France to pinpoint the radar that are in operation everywhere in the world and, most importantly, listen in to the "private" communications being exchanged over the surface of the globe, whether as part of purely military operations or in more political contexts such as the communication of a government with its embassies.

Making the Programs International

Finally, the last and most ambitious step in the plans confirmed by Pierre Joxe's appropriations bill will be the Osiris project, to be carried out between now and 2002. Osiris is a spy radar satellite, whose extremely complex system of transmitting and receiving millimetric radar

waves will be a vital complement to the Helios system. Osiris will be able to detect ground details of about three meters, in absolutely all types of weather. In contrast, optical spy satellites become inoperative at night and when overflying cloud-covered regions.

Besides a satellite that is itself complex, the Osiris program will require the ground installation of a very powerful information-processing system that can handle several billion basic data an hour. Specialists estimate that the total investment should easily exceed Fr10 billion. That is one reason the Defense Ministry is keen to "internationalize" the Osiris program, of which it would like to underwrite no more than 30 percent.

The aerospace industry considers this hefty French military space plan a real "lifeline." "For us, making the switch to these activities is essential," explains Michel Delaye, director of Aerospatiale's "Space-Defense" branch. Mr. Delaye's branch has been hit hard by the cutbacks in programs to maintain and modernize France's dissuasive force.

But competition for the approximately 50-percent share of these programs that Michel Delaye considers "ideal" for his division will be stiff. Indeed, Mr. Delaye is faced with two competitors—Matra and Alcatel—that are just as well-equipped to conduct that type of project as Aerospatiale.

Caption Information

Although the CNES's Spot observation satellites were made by the civil aeronautics industry, their main customers include military ones. Spot-Image is the firm that markets the shots taken by the satellites, two of which are currently in orbit. It has just signed a contract with the Western European Union (WEU) to supply pictures to the satellite-surveillance center it will be building in Torrejon, Spain between now and 1995.

AUTOMOTIVE INDUSTRY

PSA, FIAT Factory Reduces Robot Role

93WS0118C Paris AFP SCIENCES in French 29 Oct 92 p 51

[Unattributed article: "Fiat and PSA [Peugeot] Build a Factory Where Robots Will No Longer Reign"]

[Text] Hordain—"Fully robotized" manufacturing systems may become a thing of the past in the automobile industry. The factory that PSA (the Peugeot Company), Peugeot-Citroen, and Fiat are building in Hordain (Nord) is designed to restore the primacy of man over automata, of "basic operators" over engineers.

Some 3,500 people are expected to work there by 1995, making a line of minivans (the counterpart of the Renault Espace) marketed under the Peugeot, Citroen, Fiat, and Lancia names. The French and Italian groups have been partners since 1978 in Sevel (European Lightweight Vehicle Company) in which they own equal interests; they have already built two utility vehicle factories in Italy.

"It will be a factory of the future, but not a futuristic factory, not a 'pushbutton' factory, for we now realize that this is not the right solution," Mr. Jean-Louis Silvant, Automobiles Peugeot assistant general manager, explained when he presented the site to the press. "We want to ally quality and simplicity" in manufacturing as well as in assembly. "Engineers, who often try too hard, should allow basic operators to teach them a thing or two," he added.

Actually, this amounts to throwing back into question the "fully automated" systems that have become so popular in French factories in recent years. The principle that robots are less expensive than workers, that they work faster and do not make mistakes, is on its way out. In practice, for each job made redundant by a robot, another job is often created to maintain the machine, people at Peugeot acknowledged. Also, repeated failures often cause more damage than traditional labor disputes.

As far as quality, productivity, and improved working conditions are concerned, the progress achieved through automation are obvious in sectors such as sheetmetal working (stamping and welding in particular) or painting. They are not so evident where finishing and the assembly of complex components (e.g. dashboards) are concerned.

Criticizing the all-powerful engineers is also the fashionable thing to do. From now on, the factory shall have only "two masters, the customer and the basic operator"; such is the slogan that the project officials keep repeating. However, they are not trying to impose an assembly-line model that could be transposed anywhere. First because the factory, built from scratch and operating with a new staff, will have neither tradition nor industrial unwieldiness requiring changes.

Second, its relatively modest production capacity (500 vehicles per day) will allow for less extensive automation. The factory will also make considerable use of parts from outside suppliers: 70 percent of the vehicle added value will be subcontracted. Finally, the new factory will not be exempt from the annual productivity gain rule imposed by the PSA chief executive officer, Mr. Jacques Calvet, in order to catch up with the Japanese double-quick.

Volkswagen Manager on Efforts to Introduce Lean Production

93WS0170A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 3 Dec 92 p 7

[Article by Hans-Joachim Paul: "Flat Hierarchies and Cost Containment"]

[Text] In the automobile industry, having a German location is becoming increasingly unattractive because of cost disadvantages, while international competition is turning tougher and tougher because of the growing

globalization of the markets with the emergence of new more competitive suppliers and shorter production cycles with mounting complexity. In order to rise to the resulting raised standards in terms of costs, time and quality, fresh strategic responses are required, centered on customer orientation, the entire company's speed of adaptation and adaptability, the corporate mindset and consistent use of available technological and personnel potential. This means, first, developing a strategy for internationalizing aimed at manufacturing automobiles where the return on capital is still attractive. Next, the response has to be to rise to challenges and seize the initiative, that is, no longer reacting but rather acting and fixing new criteria for recovering the competitiveness of existing sites. This calls for reshaping production strategy at existing sites and employing new methods in the planning of factories, based on the just-in-time philosophy and the application of a continuous process of improvement and finally results in a lean plant.

[Boxed item]

Increasing competition is forcing all firms located in "high-wage" Germany to do cost cutting. In this context the organization of the workforce is coming increasingly to the fore. Flatter hierarchies and subsequently greater "on-site" responsibility for the workers promise a swifter ability to react during production and higher quality. Optimization of the logistics process also falls under the rubric of a "leaner plant." Citing his own company as an example, Hans-Joachim Paul, manager of Volkswagen AG's Salzgitter plant, describes its efforts toward greater efficiency and quality. gla.

Volkswagen's strategy for internationalizing aims at strengthening its global competitiveness and a presence in strategically important markets. Together with SEAT in southeastern Europe with a capacity for 4000 automobiles, and with Skoda in Eastern Europe with a capacity for 2000 automobiles, and with Multivans of Portugal as well as Autolatina in Mexico, our capacities for the American market are being developed. VW is present in South Africa , in Shanghai and in Changchun capacities of 1000 vehicles per day, respectively, are planned. Those countries' cost advantages are being utilized not only to protect but to enhance VW's competitive position. Hence labor costs and labor time also are playing a larger and larger role in the question of where to locate. In China, for instance, labor costs amount to a one-thirtieth of the costs in Germany. Yearly, labor time amounts to more than 2200 hours and the factory absenteeism rate ranges from 3 to 4 percent.

In addition to a consistent strategy for internationalizing, new plants have to be planned and constructed using fresh methods and designs in order to overtake the competition and old plants need restructuring in order to meet competitive standards. It is therefore best to use 'just-in-time' principles to design the entire plant as a single harmonious process so that the material can flow through the plant over the shortest route, in the shortest time, with the least possible investment and without waste. Hence 'just-in-time' is taken to mean not only the linkage of external material flows with the plant, but likewise the harmonization of technological processes with logistic flows. It must be realized that testing, full containers, forklifts and the transport of material with all kinds of means of transportation as well as refinishing and rejects represent waste. Waiting for the locksmith, toolmaker and electronics engineer also represents waste. It makes more sense for skilled workers, working on the machinery, to be trained on the workpiece so that it can be repaired without further ado. This leads away from a task-oriented plant design toward a product-oriented form of design layout. In this connection a satellite-design layout has proven particularly effective. Assembly components are delivered directly to the assembly point. Containers are docked at the spot where the material is required. There is no temporary storage, repacking, mixing and sorting of parts in a central warehouse. The result is a direct link between assembly and machine production via direct feedback mechanisms such as the Kanban control device.

Besides new layout design approaches, the organization has to be made lean. This means a thoroughgoing elimination of nonproductive activities and keeping required service functions at productive-activity levels. This demands a new structural organization that does away with current performance limits, reduces interfaces and establishes on-site service, responsibility and accountability. In this way the basic conditions for a process of continual improvement are created and the potential for increased efficiency is tapped. This takes on special significance in the context of the possibility of installing and operating internationally machinery and plants from Germany, Japan and other industrial countries. Therefore, because of identical standards of technology around the world, only someone able to make more intelligent use of those plants and machinery can realize competitive advantages. Volkswagen's commitment in Shanghai affords an example of the application of these principles: the terms of the plan call for a plant able to turn out 100 automobiles daily and simultaneously for an engine factory producing 330 engines a day. The plant was initially planned in the conventional way. Half of the assembly bay consisted of space for manufacturing and half of space for refinishing. Ditto for the paintshop and bodyshop. After an intensive examination of 'just-in-time' principles and statistical comparisons with leading competitors worldwide, the plan had to focus on new variables:

- How many automobiles more are being manufactured per square meter of building space than by the leading competitors?
- Per automobile, how many investments are yielding less?
- By how many percentage points is the quality better than that of the leading competitors?
- How many turnaround (tied-up capital) days are required?

This presented the plan with a challenge of an entirely new dimension even though up to now the focus was continually on the latest technology without consideration for the entire surrounding field and system. In order to meet these standards all the repair surfaces were eliminated from the layout and the paintshop, assembly and bodywork sections correspondingly enlarged. In this way the capacity rose from 100 to 250 vehicles per day. By designing more harmonized processes and directly linking internal and external suppliers, corresponding to the satellite design for assembly, it was possible to cut down on storage and buffer zones. Concurrently, the organization was transformed through team-organization with fully responsible workers working to assure quality, service and output. Electronic and mechanical engineers were made responsible for the processes in the plant. The hierarchy grew flatter.

It is not only new factories that require new planning principles. Even existing factories need restructuring if they are to achieve competitiveness. Volkswagen in Salzgitter, the world's largest automobile engine plant, embarked on such a restructuring. Compared with the world's best, Salzgitter had the most surface area per engine, the most workers per engine, the highest investments per engine, the largest tie-up of capital per engine. This list could be continued further but it already indicates that there was considerable potential for improvement possibilities. The Salzgitter reorganization was done with a staggered plan that commenced with a segmentation of the plant that lead to the establishment of four cost centers and reduced the interfaces in the organization. In this connection the principle of task-orientation was dropped and manufacturing was organized with a product focus. Each cost center is fully responsible for the logistic chain for a single engine family. The cost centers have complete product responsibility and a manufacturing flow that tracks with the material flow: the cost centers encompass both assembly and mechanical sectors that are interconnected as automatic closed-loop control systems via bypass modules. Plants with large capacity cross-sections and batch sizes are likewise linked together via bypass modules that are controlled according to the Kanban principle. There was total integration of indirect functions allied to production. Thus the quality assurance and service functions have been decentralized to the maximum extent possible and integrated into the engineering cost center. The remaining indirect functions, especially series planning and logistics, were organized with a product focus. In this way it was possible to achieve as completely as possible cost responsibility for the cost center manager. By extension of the indirect functions the cost-influence potential was magnified. The cost center manager assumes maximum cost responsibility under his own budget.

Underlying the functionability of this system is high plant availability and quality. This can only be realized if conventional safe thinking is discarded and a basic grasp of the 'just-in-time' philosophy is appropriated: "Inventories conceal flaws." This realization leads to a cycle that sounds relatively simple: reduce turnaround in the plant, increase risk, augment the pressure and in this way reveal problems and provide a solution. Problem solving then enables increased productivity. This method inevitably leads to optimization of plant availability and quality and consequently to the optimum factory—to lean manufacturing.

For this it is necessary that all workers not only be productive, but they should also spontaneously reshape and optimize the factory from within, focusing on goals and results. They must be put in a position to translate, with the support of the organization, the many small possibilities for improvement into increased quality and productivity. A continual process of improvement plays a major role in this connection. The continual process of improvement [KVP] is the opposite of smugness and calls for constant improvement of everything and involves individual workers on all levels in the organization. Motivation is enhanced through better performance of the many small things and being confronted with a succession of higher goals as well as visualization of ideas, improvements, procedures and results for all workers. Hence KVP, in principle, encompasses avoidance of any sort of waste, product quality improvement, enhanced productivity, refinement of resources and optimized organization of the work force and work flow. The objective is to be generally better than the competition in terms of quality, productivity and costs, internal and external customer satisfaction, optimum production runs and harmonization of the entire factory. Introduction of KVP starts with a sensitivity and motivation phase, through talks with workers and foremen concerning comparisons with the competition, failures in the field, and refinishing and rejects developments. This leads to finding problems with the actual situation. In the next phase general objectives need to be defined and through the application of brainstorming and meta-plan techniques, proposals for improving product quality and refining resources need to be realized. In the activity phase the proposals are tested for plausibility and evaluated, priorities are set, procedures are introduced and the activities are visualized. Monitoring of the results is accomplished by comparing the ideal with the real in discussions and on-site visualization, and this in turn produces fresh impetus for ideas and finally a continuous cycle emerges. A "problem-free" organization was introduced as a prop. The cost center structure not only yielded identification with a specific engine family but also eliminated the interfaces between mechanical production and assembly. Concurrently, the engineering cost center was introduced on site as a prop for the (problem-free) workers. With the decentralized workplace linked to the engineering cost center there is an effective prop for the KVP process based on the motto: get rid of problems, do not manage them, and mistakes can be made but not repeated. Simultaneously the indirect workers are assigned on site to the processes. In this way the responsibility is personalized. Each worker has a customer, either one on the outside who is buying the product or an internal customer inside the factory.

Management and service sector activities are thereby focused on local needs since that is where value is being produced.

The workers are organized into teams for the assurance of quality, service and production. Each team represents a closed loop, derived from the technical closed-loop cycle. The team spokesperson constitutes the control element and assures that his team carries out its assignment. Each team has a management assignment, thereby autonomously deriving goals from the corporate objective and exercising control over the results. As a whole the team organization constitutes a zero-defect industrial organization. The usual addition of defects is thereby avoided. Each team purchases local units exclusively. Each team autonomously plans the attendance and simultaneously sees to it that there are always enough workers to be able to run the plant. Professionalization occurs on the team and at the workpiece so that, for example, any worker can operate any machine and each team has mechanical and electronic engineers to service the plant if repairs are required. It is management's job to arrange leeway enabling the workers to exercise their creative potential. Concurrently, the organization has to be structured in such a way that at any time effective service is performed on site for the net product process. The outstanding results from the pilot projects show that all resources are far from being exhausted. Many small steps lead practically with investment costs to a significant improvement in productivity and quality.

Worker motivation is significantly improved through results-oriented work. Illnesses declined by nearly 50 percent in the pilot projects. Furthermore, it was possible, for instance, in the manufacture of tappets to cut throughput times and inventories by 30 percent, defect costs by 50 percent, storage areas by 17 percent, repair costs by 47 percent, tool and transport costs by 11 percent, production time by 10 percent, unit costs by 8 percent and increase the plant's degree of utilization by 15 percent. Meanwhile, throughout the factory there are standard bulletin boards to help orient the workers. These contain information on the plant and cost center as well as on personnel (accidents, for example), product (for example, analyses, comparisons with the competition) and resources. At the same time results and objectives are visualized. Defined activities and the introduction of procedures make what is actually occurring transparent and lay the groundwork for worker involvement Moreover, workers and teams that exceed the goals for improved productivity, quality and tied-up capital should be recognized.

At the Salzgitter plant even the organization of the workforce was revolutionized with the introduction of the new VR-6 engine. On this net product line it is all teamwork based on the 'just-in-time' philosophy.

It should be noted that there is a tremendous potential for improvement possibilities in German factories. The approach indicated enables tapping that potential with a new organization of the workforce into teams working at making continual improvements. Management has to be convinced that there are possibilities for improvement everywhere if competitiveness is to be maintained. Anyone not accepting these possibilities for improvement also has no scope for the process of continued improvements. This requires workers having fresh ideas and an inner striving for perfection.

BIOTECHNOLOGY

German Company To Plant Genetically Engineered Sugar Beets

93WS0078A Frankfurt/Main FRANKFURTER ALLGEMEINE in German 21 Oct 92 p N1

[Article by "bh": "Genetically Transformed Beets in the Field? Applications for Release of Genetically Engineered Plants"]

[Text] The Planta company, a research company of Kleinwanzlebener Saatzucht AG [Seed Cultivation German Stock Corporation] in Einbeck, has filed an application with the Federal Public Health Office for outdoor experiments with a genetically engineered sugar beet. It is a question of the first release application for a commercial enterprise in Germany. There have thus far been only two outdoor experiments with genetically transformed plants here in Germany. Researchers at the Max Planck Institute for Cultivation Research in Koln-Vogelsang have grown outdoors, for research purposes in the last two years, petunias that have a color gene from maize.

Scientists at the Lower Saxony plant cultivation company have transplanted into the sugar beet a single gene of a virus—to be more precise, the genetic code for the viral envelope protein. The foreign gene makes the genetically transformed beets resistant to the cause of so-called "root beardedness" (rhizomania). Here it is a question of an increasingly more spreading viral disease that results in considerable crop loss, because the beets' growth is stunted. The viral disease, transmitted from a soil fungus, has thus far not been able to be effectively combatted. In sugar beets containing the viral envelope protein a harmless virus infection is simulated, as it were, and the multiplication of dangerous viruses is prevented in this way. In the planned field experiments they want to test how well the genetically transformed sugar beets resist the cause of the disease under outdoor conditions. In addition, they want to study how environmentally compatible the genetically engineered sugar beets are.

They want to grow the resistant plants this coming April in an area totaling 1800 square meters in the vicinity of Einbeck as well as near Deggendorf in Bavaria, where rhizomania is quite widespread. The Berlin Institute for Gene Biology Research has also filed an application for outdoor experiments—as already briefly reported. In conjunction with Kleinwanzlebener Saatzucht, a genetically transformed potato is to be grown that practically forms only one kind of starch (amylopectin). This form of starch

is interesting for the production of binders, for example. Other companies are also at present preparing for the release of agriculturally interesting plants in Germany.

In past years German researchers made valuable contributions to the development of technologies that make possible the transfer of genes to plants. While genetically transformed plants have already been grown in more than 500 trial fields worldwide, this progress has been substantially hindered in Germany.

Plans for New German Law on Genetic Engineering

93WS0104C Duesseldorf HANDELSBLATT in German 12 Nov 92 p 6

[Article by sm: "New Law to Create Breathing Space for the Industry"]

[Text]

Genetic Engineering/Union for Public Service and Transport (OTV) Warns Against "Dilution"

The new genetic engineering law is to take effect as early as the summer of next year. This law is to create new breathing space for scientists and industry in this area without increasing risks to health or the environment.

Christian Lenzer of the CDU/CSU Bundestag faction and Professor Hans Laermann of the FDP faction are the spokesmen for research policy. They developed an appropriate schedule when presenting a bill that is to be passed today in the Bundestag.

Based on this bill, the federal government is to produce an amending law by the end of January or the beginning of February. This amendment will be considered in the parliamentary committees until early summer and then passed. Lenzer and Laermann are optimistic that the Bundesrat will also approve the amendment.

Already, the research committee of the Bundestag agrees with the SPD on 60 to 70 percent of the desired changes. Room for maneuvering in providing concessions to the Social Democrats is seen in giving information rights to the works councils in this area and to forbid by law military exploitation of genetic engineering, something also condemned by the coalition.

In the Lands with an SPD government, the need for amendments is assessed very differently. In spite of this, the research policy-makers of the coalition assume that several SPD Land governments will agree to the coalition plans because of problem pressure in their area of responsibility. Because of this, Lenzer and Laermann expect a majority in favor of their initiative even in the Bundesrat. According to the bill from the CDU/CSU and the FDP, the federal government is to present a draft to amend the genetic engineering law immediately. The following items are to be given particular attention in this draft.

- The compulsory registration and the associated waiting period of three months to commence work for research purposes in newly registered facilities of security stage one are to be replaced by compulsory notification.
- While retaining compulsory recording, the compulsory registration for additional work for research purposes of security stage two is to be eliminated. Besides, the compulsory approval for facilities for research purposes of security state two is to be replaced by compulsory registration.
- The criterion of "small scale" is no longer to be used to limit work for teaching, research and development purposes vis-a-vis commercial work.
- It is to be clarified that the international exchange of genetically altered organisms for research purposes does not require approval.
- The compulsory records and the forms will be simplified.
- The federal government is to pass a regulation to designate organisms whose distribution can be limited.
- To create greater legal security and improved assessment potential in the classification of genetic-engineering work in the individual security stages by the responsible scientists, the list of organisms is to be expanded and better defined.
- To maintain effective worker protection, it is to be determined whether and to what extent preventive medical checkups and compulsory storage need to be retained in the current scope.
- The teaching material for mandatory courses for project managers should be limited to essential topics.
- It is to be determined whether using genetically altered organisms as living vaccines can be regulated under the drug laws.

In addition, the federal government is to become active with the EC Commission with a goal of achieving an amendment of EC standards insofar as these conflict with national genetic-engineering law and the objectives of the bill.

The OTV chairperson Monika Wulf-Mathies was concerned over plans to amend the genetic-engineering law. Priority must be given to the protection of humans and the environment above all other objectives. The intended improvement in framework conditions for basic research in molecular biology has its limits where danger for employees, the population and the environment would have to be accepted.

Finland: Biotechnology Research Park Planned for 1994

93WS0142A Helsinki HUFVUDSTADSBLADET in Swedish 3 Nov 92 p 3

[Article by Henrik Stenback: "Both Science and Industry Involved in Research Park"]

[Text] It will be the task of genetics professor Jim Schroder to steer the big biotechnology project in Vik to its conclusion.

The research park in Vik has been under discussion for a long time. The project has not really gotten under way because of a protracted land dispute between the state and the city of Helsinki.

While the situation was deadlocked in Helsinki for several years, other cities with technical universities have been drawn by the boom in the biological sciences and have built biotechnology centers along the lines of Biocity in Abo.

The land dispute in Vik was settled this spring, which means that construction of the planned biocenter in Vik can now begin. An effort will be made to submit the land agreement and the planning of the area to the city council before the end of the year.

"I believe our timing is good. When we build the research park in Vik we can learn from the mistakes that were made during the first biotechnology wave. In the euphoria many people burned their fingers," said Schroder, who was recently appointed as head of the Vik research park.

Schroder is a professor of genetics at Helsinki University. At the end of the year he will be relieved of his teaching duties. He will devote half his time to the research park. The other half will be spent in research.

Modeled on Stanford

The scientific research park in Vik will be built and operated by a company formed for that purpose.

The company is made up of three equal parts: the city, the state and industry. Industry is represented by its central organizations while in practice the state is Helsinki University. The chairman of the board of the research park is Helsinki University President Risto Ihamuotila.

However, contrary to what one might think, the research park will not be built with funds from industry or the business sector, according to Schroder. The two building complexes in the research park will be financed by Helsinki University and money from the national budget.

"Industry will enter the picture at a later stage. The research park must first show that high-class biotechnology research is being carried out there. Then we can induce industry to join us," said Schroder.

He should know what he is talking about. In the late 1970s and early 1980s he spent five years at Stanford University as a visiting researcher and was able to familiarize himself with Stanford's Science Park, which is the American model for the research parks that have been set up in Europe.

Money and Research

The time he spent in the United States was successful for Schroder and also serves to demonstrate that a scientist does not have to barricade himself behind his books and test tubes. Together with a colleague at Stanford, Schroder began to cash in on his research findings in the diagnostic area. They formed a company that was listed on the stock exchange in the United States a few years later.

"The American tradition sees no conflict in a cooperation between science and industry. Therefore it is not surprising that the most outstanding research results come about in precisely this kind of cooperation. Especially during the Reagan era, when the universities had a hard time, many of the best researchers turned to industry, which had the resources," Schroder said.

"Unfortunately it is the exact opposite here," he said.

It is unfortunate in the sense that industry does not get hold of the top people in research. It is more prestigious to carry out research at a university.

"In Europe, status depends on how many titles one has, while in the United States everything is measured in terms of how much money one has," Schroder pointed out.

Money for Construction

Although the Vik research park is aimed at eliminating the barrier between science and industry, it is primarily a university project.

"The university is the scientific core, but industry's role will be important in the future," Schroder maintained.

The research park will cooperate closely with the agroforestry science department already in Vik.

All the university's bioscience units will move to Vik with the exception of the medical school's biological institutes in Mejlans and on Brobergs Terrace. This is based on the assumption that botany and zoology will choose Vik rather than Gumtakt in the future.

Jim Schroder talked about two building projects in Vik, 1A and 1B. 1A will be financed with money from the state budget while 1B will get under way as early as next year with the help of Helsinki University's own funds.

"It will be financed with the money that is obtained when the Finnish Chemistry Institute's old property in the inner city is sold," said Schroder. He would say no more on the subject but he assured us that someone is interested in buying the property at Berggatan 20.

It will take several years to build the 1B complex. Schroder thinks it is realistic to expect that work will start on 1A in 1994. The original intention was to build 1A first but plans were changed when the 1993 budget appropriation for the research park was cut.

The pharmaceutical, biochemical and genetics institutes will be housed in 1B along with the animal research laboratory.

According to plan, 1A will hold the microbiology, elctron microscope and biotechnology institutes. In addition space will be reserved to accommodate industry.

"When the buildings are ready at the research park a thousand researchers will be concentrated in Vik, including the 450 researchers who are already working in the agroforestry science facilities.

"This will be more than the university's playground. We expect the research park to attract leading foreign scientists and foreign venture capital," Schroder said.

In the 1990s Vik, in combination with the new university district in Gumtakt that is currently under construction, will give a new structure to Helsinki University which has long been split up in the inner city. The humanities and social sciences will remain in the city center, while the natural sciences will be located in Vik and Gumtakt.

DEFENSE R&D

GEC Ferranti Develops Pulse-Doppler Radar for Small Fighters

93WS0064E Stuttgart FLUG REVUE in German Oct 92 p 86

[Article by K. Schwarz under the rubric "Technology Magazine": "GEC Ferranti Blue Hawk; Radar for Small Fighters"; first paragraph is an introduction]

[Text] GEC Ferranti is developing with its own funds the favorably priced Blue Hawk radar for retrofitting programs and new small fighters.

Low cost and simple adaptation to various airplane models were the main goals when Ferranti—in the meantime absorbed by the GEC group—began work at the end of the eighties on a new pulse-Doppler radar. While extensive system tests are now already being conducted at the Milton Keynes plant, the company has intensified its marketing efforts for the Blue Hawk.

An attempt is being made to lure above all manufacturers of light fighter jets and countries that have an interest in retrofitting programs. Not only absolutely top performance, but also cost effectiveness play an important role in this market segment. Still, the Blue Hawk is a full system with air-to-air and air-to-ground operating modes.

The radar operates in the I band with a low, medium or high pulse repetition frequency according to requirements. Accordingly, the speed of approaching airplanes can be determined, and tracking of an individual target is just as possible as vertical scanning and searching in the head-up display field of view for air combat. In attacks on ground and sea targets the Blue Hawk can be used as a range finder or for making radar charts. Its range for small vessels is to be from 77 to 100 km, and air targets the size of a fighter can be spotted from distances of about 80 km.

The flat antenna's pivoting range is +/- 60 degrees. Its size can be set according to the mounting space. The Blue Hawk's three additional black boxes are the transmitter with its air-cooled traveling wave tube, the receiver and the digital computer. The latter uses, according to GEC Ferranti's data, only 50 percent of its memory capacity in the basic version and can accordingly easily handle new software. The radar is already now very resistant to interference and is also able to illuminate targets for medium-range guided missiles. The Blue Hawk weighs a total of 107 kg. The time between failures is to come to 250 hours.

GEC Ferranti views as the main competitors radars like the APG-66 from Westinghouse, the FIAR Grifo or the Elta EL/M 2035. They are all courting retrofitting programs for the F-5 Tiger II, the A-4 Skyhawk, the Mikoyan MiG-21 or the Chinese Super 7. Besides, the British Aerospace Hawk 200, which is presently flying with an APG-66, presents itself, of course. Serious talks are already under way with two potential customers, according to GEC Ferranti. The company is figuring on sales of far more than 1000 units starting in 1995-96, when the Blue Hawk is expected to be available.

UK: European, American Companies Interested in CASOM Project

93WS0206A Paris AIR & COSMOS in French 4 Oct 92 pp 42-43

[Article by Pierre Langereux: "A Rash of Candidates for Britain's 'CASOM'"; first paragraph is AIR & COSMOS introduction]

[Text] European and American missilemakers are keenly interested in the RAF's plans for an air-to-surface standoff missile.

The cream of European and American missilemakers are interested in Britain's CASOM [Conventionally Armed Stand-Off Missile] airborne missile project, known officially as the SR(A) 1236 program. The CASOM is an air-to-surface standoff missile, equipped with a single, classic warhead to attack "hardened" fixed targets such as aircraft shelters, conspicuous bunkers, tactical centers, and so forth from a great distance. The missile, which will have to be "affordable," is slated to arm the RAF's Tornados, perhaps the Royal Navy's Harriers, and, if it exists, the EFA.

Already nearly 20 preprojects have been announced since the MoD began preliminary consultation on the technologies applicable to the CASOM last July. Indeed, the bid invitation has not yet been published and is not expected to be before early 1993. The late interest of the Royal Navy has postponed the deadline. Moreover, the MoD has not yet specified either the type or number of missiles it is considering, but estimates making the rounds cite about 500 to 2,000 missiles for the Royal Navy and the RAF.

On the other hand, preliminary technical specifications for the CASOM call for a terminally-guided, semi-autonomous (with navigational resetting and in-flight target reassignment) missile, which will carry a single conventional and later a submunitions warhead. It will have to have a range of "over 100 NM" (+185 km).

"Turbo" Missiles

Competition to make the new weapon is already well underway, as was evident at the Farnborough Show where different CASOM preprojects at varying stages of development were on display.

Rockwell International (USA) unveiled its AGM-130 "turbo" project, which features a Williams P8300 turbofan with thrust of 450 kg, at Farnborough. Rockwell is actually offering two versions: a heavy 1,360 kg (3,000 lb) missile with a 900-kg BLU-109 type warhead; and a light 900-kg (2,000 lb) missile with a 360-450-kg BFR-830 type warhead. Dropped from an altitude of 600 meters, the missiles boast ranges of 230 and 160 km respectively. They also have a "wait in flight" capacity of about 8 s/km. Rockwell has combined GPS navigational satellite resetting with a radioaltimeter and a data link to handle the missiles' inertial guidance. An infrared-image or video homing head combined with image-matching guide the missiles to their termination point.

Hughes Aircraft (USA), which has just bought General Dynamics, has inherited the AirHawk, a derivative of the Tomahawk cruise missile offered to the RAF. The AirHawk borrows the Tomahawk's airframe, but its guidance and propulsion systems are less costly. It features infrared-sensor terminal guidance, GPS-resetting inertial navigation, and a Teledyne CAE J402 turbojet.

McDonnell Douglas (USA) is presenting a derivative of the SLAM, the ground-attack air-to-surface missile that is derived from the Harpoon antiship missile (also equipped with the J402).

In the United Kingdom, British Aerospace is banking on both the Golden Eagle, a derivative of the Sea Eagle antiship missile, and the Revise, the prototype for a future Mantis airborne cruise missile. Hunting is offering a turbopropelled derivative of the airborne antitank SWAARM 2 missile in conjunction with MBB (Germany) and Alliant TechSystems (USA).

However, DASA has just announced that MBB, together with Hunting Engineering and Bofors (Sweden), is proposing the "Kinetic Energy Penetrating Destroyer 250," so named because it features a turbofan (Microturbo or Rolls-Royce/Williams). The missile will have range of 250 km. The KEPD 250 will be guided by an infrared homing head and equipped with a laser telemeter to trigger the "Cannon-Davis" type kinetic-energy warhead. According to Deutsche Aerospace, the prototype will come out between now and the end of 1992 and flight tests will begin in 1993.

In Italy, CASMU partners Alenia and BPD are proposing a turbo version of the Skyshark that weights 1,500 kilos and has a range of 250-600 km. Flight testing is scheduled to begin in 1993 (see AIR & COSMOS, No. 1392).

In France, Matra is offering a derivative of the Apache air-to-surface missile it developed with Aerospatiale to equip existing fighter planes—the Tornado, F4, F16, F18, and Mirage 2000s—by 1996. The French Air Force has already chosen the Apache for its Rafales and the Luftwaffe has selected it for its Tornados. Matra and MBB have created an Apache-MAW manufacturing group to develop the derivative.

The current turbopropelled Apache has a range of over 150 km and carries over 500 kg of submunitions for a total weight of 1,230 kg. For the British program, Matra is proposing an Apache derivative with a datalink. The link will not only allow operators to divert the missile to another target in flight, but (using a heat camera) to designate its termination point and verify the results of the engagement after the (single) warhead has been dropped onto the target. This version has a range of 250 km. Matra is also looking into deriving other tactical cruise missiles (conventional, stealth, single or submunitions warhead) from the Apache. They would have ranges of over 400 km. One would be guided differently from the Apache, and the other would complement it. According to Matra, this plane- or ship-firable version could go into service in 1998-2000.

ENERGY, ENVIRONMENT

Electric Auto Field Test on German Island of Ruegen

93WS0078B Frankfurt/Main FRANKFURTER ALLGEMEINE in German 13 Oct 92 p T3

[Article by Joh.-Chr. Spira: "The Battery Is the Key; Opportunities for Zero-Emission Autos/Big Test on Ruegen"]

[Text] The biggest German field experiment thus far with electric current as the driving energy for automobiles is to last for four years. Experience will be accumulated on the vacation island of Ruegen beginning in October with 60 different electric automobiles (passenger cars and commercial vehicles). The large-scale use of zero-emission automobiles will cost over 40 million German marks [DM] (the Federal Ministry for Research and Development is contributing approximately DM22 million) and will run to the year 1995. With this the German automobile manufacturers and their suppliers are taking on for the first time in this field on a large scale tests by consumers under everyday conditions. Eight BMWs of the No 3 series, 10 Mercedes-Benz 190s, 10 Mercedes-Benz Transporter MB 100s, 3 Neoplan 8008 E Metroliner buses, 10 Opal Astra Caravans, 9 VW Golfs and Jettas, and 10 VW T4 minibuses, all having an electric drive, will be used. The electric automobiles will

be of service in municipal and public departments, health resort administrations, skilled-trade businesses, local branches of motor vehicle manufacturers, the post office and in the bus shuttle service.

Important performance characteristics and also the vehicles' suitability for everyday use and the life of their components will be studied by means of the most up-to-date measuring systems by Dresden Technical University. In addition, they want to accumulate knowledge concerning the electric power required and the efficiency resulting from it. The Institute for Energy and Environmental Research in Heidelberg wants to prepare with the aid of the resulting data a comparative study between electric vehicles and automobiles having Otto or diesel engines of comparable capacity.

The Ruegen project is of added importance to project leader Professor Christian Voy (Deutsche Automobilegesellschaft [German Automobile Company]—DAUG), because it will be included in a long-term universally coordinated market introduction strategy for electric vehicles. For the broad public acceptance of electric road vehicles is also to be promoted precisely by means of this project. After all, the electric automobile is still far from possessing general merits in the criteria of power and range. And the price level will be discussible not until it is produced in greater quantities. But only increasing attractiveness can produce greater quantities.

That is why it is altogether reasonable if extremely environmentally compatible energy sources like battery systems as the key equipment for the electric automobile are being subsidized through high taxes. In any case the planned introduction of the electric automobile represents a special challenge for the battery manufacturer. In the final analysis, the main benefit of the electric automobile as a zero-emission vehicle is local freedom from emissions. At the same time the automobile industry has to expand with electric vehicles its own range of offerings in its customary price lists. For it is a matter for this important branch of German industry of maintaining competitiveness with electric vehicles too in the years to come. "Only to the extent that an automobile company is able to offer a suitable zero-emission vehicle," Research Minister Heinz Riesenhuber predicted at the start of the Ruegen experiment, "will it survive in the long run in this extremely big and dynamic market."

Of course, the legislation for California is now regarded as the motivational push for forcing the development of electric automobiles in the industrialized nations. A gradually increasing percentage of sales of automobiles without exhaust gases is prescribed there from 1998 on. But emission concentrations have assumed dramatic forms in large cities in other areas of the world too. Consequently, from good to very good market opportunities are being predicted over the longer term for so-called zero-emission vehicles. That is why Voy recommends strong support for emission-free vehicles in Germany also through government support measures. This starts with tax exemption and lowered electricity prices and extends to financing systems for those changing over, or reduced-rate special parking lots.

In all the electric vehicles that have been made available thus far by German automobile manufacturers, it is a question of mass-produced internal combustion engine models that have been modified for an electric drive. So, as project leader Voy asserts, there is already well-founded knowledge concerning the reliability or dependability of the standard equipment of electric vehicles and relatively favorable re-equipment costs as compared to new development. Above all, the crash behavior of completely equipped electric vehicles having various battery systems has already been studied.

The key piece of equipment for the electric vehicle is the battery as the storage device. Meanwhile a wide selection of energy source systems is available for an electric automobile suited for everyday use. In addition there have been decisive advances in electronic management making it possible to control the use of battery power in the most economical way. Only lead-acid batteries or maintenance-free lead-gel versions, like Bosch and Varta make, for example, have been available thus far among batteries for mass-production use. Among alkaline systems sealed maintenance-free FNC batteries have appeared in the quest for longer ranges. ABB [Asea Brown Boveri] has developed the sodium-sulfur battery and AEG [Allgemeine Elektricitats-Gesellschaft (General Electricity Company)] the sodium-nickel-chloride battery in the area of high-temperature systems operating at about 300°C. In a battery comparison it is a question of important criteria like weight, range, life and number of charging and discharging cycles, and also of speed or acceleration up to the ability to climb hills.

France: Nanofiltration Process Successful

93WS0118B Paris AFP SCIENCES in French 29 Oct 92 p 37

[Unattributed article: "New Process to Obtain Chlorine-Free Water at Auvers-sur-Oise"]

[Text] Pontoise—For the first time in the world, a prototype plant will produce very pure water softened through nanofiltration that will no longer require any chlorine addition in the water supply system.

According to the experts who presented their work to the press on 22 October, no bacterial growth can occur in water thus filtered, and therefore there is no longer any need to use chlorine; consumers will be guaranteed tap water as pure as most mineral waters.

Thanks to this experimental process of the Ile-de-France Water Syndicate, Auvers-sur-Oise (population: 6,000) will get chlorine-free water starting in early 1993. Water from the Oise River will be decanted and filtered by traditional methods through membranes having a porosity of 10 angstroms, i.e. sufficient to retain the

micropollutants, including pesticides, viruses and bacteria, and organic matters that might promote the growth of microorganisms.

Following satisfactory results in a "pilot plant," two nanofiltration units with a capacity of 75 m^3 per hour were built at the Mery plant and, with the agreement of the Ministry of Health, which had studies performed similar to those preceding the introduction of a new drug, the water will be distributed via the regular water-supply system.

An information campaign is in progress to acquaint the public with the new taste and new ways to use the water. In particular, less fabric softener will be needed in the wash, and dishwashers will require adjustment. Also, the same quantity of soap and related products will produce more lather.

Germany: Improved Diesel Engine With Less Pollution, Fuel Consumption

93WS0172C Duesseldorf HANDELSBLATT in German 17 Dec 92 p 18

[Article by Bernd Genath: "Oil Vapor Engine Propelling Truck Could Clearly Save Fuel"]

[Text] HANDELSBLATT, Wednesday, 16 Dec 1992—The new borderless freight traffic in Europe is going to highlight old limits: those of the conventional truck engines with their uncontrolled soot, tar and nitrogen oxide emissions. An alternative to the familiar diesel process, however, the oil-gas engine, could elevate environmental protection in freight transport to higher levels. The developmental work that still needs to be carried out is clearly defined and is considered solvable.

The Juelich research center is the seedbed for the new diesel process and its further development is presently in the hands of Siegfried Foerster, Ph.D. (Engineering). In the first phase it first vaporizes water with energy from the exhaust and in the second phase it vaporizes the fuel in that vapor. Afterwards an injection valve injects the resulting oil/water vapor mixture, under a 120 bar pressure, with sonic speed and with 300 to 400°C temperatures, into the at least equally hot air in the cylinder, with spontaneous ignition starting the combustion.

This scenario leads to new sorts of internal engine features:

- First, on the plus side is the virtually complete elimination of soot since the quantity of the latter is in linear proportion to the over-lubricated combustion areas near the unexhausted liquid droplets in the combustion chamber of the familiar diesel principle. The Foerster process does not allow for such exhaust flaws.
- Second, a drastic reduction in nitrogen oxide is noticeable. Again, the reason is that in the prevailing process there are especially hot areas that naturally promote the formation of nitrogen oxide. These do not exist at all in this process and, additionally, the water vapor has a cooling effect on the combustion.
- Third, additional water vapor in the engine cycle leads to a reduction of specific fuel consumption.
- Fourth, with the auto-ignition temperature lowered from 600 or 700°C to values approaching 300°C, this type of engine enables a reduction of compression ratios to 10 or 12 and thereby to gasoline engine values. It is therefore possible to employ light metals and economize on engine weight.
- Fifth, because of clean combustion in the air taken in, more fuel can be added than in current diesel engines. That satisfies the desire for increased yield per liter to gasoline engine values, do so under conditions that dispense with the exhaust turbocharger common at present.

With a view to minimizing the emission of pollutants and CO_2, all these wonderful qualities still call for optimizing perhaps the combustion process in terms of excess air, compression ratio and water vapor. This parameter allows 10 to 30 percent increases, respectively, in the effective degree of fuel economy together with carbon dioxide reductions of the same amount.

Drawback: An Extra Watertank Is Needed

On the minus side, demineralized water is required for processing the mixture. Oil vaporization requires as much as three parts water to one part fuel. The ideal ratio has not yet been discovered. This parts research is included in the package of detailed research still not carried out.

Water as a medium explains the hesitant steps towards mobile oil vapor diesels. For such a mixture requires different structural-design and mechanical-engineering steps that are unproblematically solvable in stationary use. For this reason the main development focus is still on immobile propulsion systems. For example, the vehicle has to bunker the water supply. However, not in the indicated ratio to the diesel oil since the vapor can be condensed out of the combustion gases.

This complex likewise is among the issues to be resolved: how much cooling down should there be? Condense out the entire amount of water vapor and therefore take along only a small amount? Or is a smaller air cooler with a larger spare reservoir better for practical operation? Moreover, how will the process react in summertime and in wintertime? Is a supply of water with glycerin added as an antifreeze sufficient to cross off this point as done and over with?

Moreover, the cold start in the experiment still needs some discussion. A cold-start igniter in the path of the exhaust gas, bridging the minutes it takes for the self-warming process to begin could be an approach to initial vaporization. Thus the Foerster engine will not be absolutely more voluminous. Compensating, as it were, for the "preheating" components, the Juelich variant

emerges without a soot filter as environmental protection expects at present of the old process. Such soot filters are lavish, costly and also require separate heat energy.

Developer Siegfried Foerster recommends his principle primarily for vehicles with long running times-transregional long-haul traffic-and quite constant operation. For, in partial operation there is a threshold where the degree of vaporization is in danger of declining because of exhaust gas temperatures that are too low. However, to reach that point the diesel really has to be extremely underdriven. As a rule, exhaust gas always contains much more energy than the vaporizer consumes. And the cold-start igniter could in the meantime temporarily bridge the "temperature gap." However, the most severe problem in mobile application that the engineer sees, is stabilization of the vaporizer, considering the fluctuating dynamics of the engine and associated fluctuations in exhaust gas temperature. This shortcoming does not occur in the stationary sector, for example, in the power thermocoupling with constant high output and constant revolution.

Notwithstanding, all preliminary research holds forth the prospect of the oil vapor diesel realizing the current clamorous demand for a car that consumes only five liters per 100 km. Naturally this final stage still looks to the man from Juelich like pie in the sky. When he speaks of vehicle use, he rather envisions long-haul and rail traffic, the propulsion system in ships or construction equipment.

New technological know-how is not demanded of the engine designer. For there is not a great deal that changes on the units. The actual diesel engine that requires a direct-injection suction-device of ordinary make is in no way affected. Only the injection system is exchanged, with the oil vapor system, that is, vaporizer and injection valve in lieu of injection pump and injection nozzle. Two small feed pumps are also added, one for water and the other for oil. They need produce at most pressures up to 120, not 1000 bar, as required of injection pump manufacturers at present for the purpose of as sootless a combustion as possible.

Furthermore, in the commercial vehicles sector an air cooler has to be flange-mounted. Still, that adds just a little bulk to the configuration. In its place, on every modern diesel, is the charged-air cooler of the exhaust-gas turbocharger. Additionally, at the most, the vaporizer and the condensed water reservoir need to be attached.

Redevelopment work of a machine processing sort still needs to be incorporated in the injection-valve drive. Because of the larger volume of vapor to be injected, they are currently massive and inject round-about into the cylinder like a screen valve. The question arises: magnetic or hydraulic? A very rough estimate of the liter yield of a camshaft controlled valve terminates at 50 to 60 kW. For a six cylinder machine that amounts to 360 kW. Hence it is a kW range that covers a broad spectrum of applications in the commercial vehicle sector.

Based on significant responses from the stationary oil vapor diesel engine (various notable industrial firms in the combustion engine sector remain in touch with him), Siegfried Foerster believes also in a rapid parallel development for rail, road and shipping. The alarming CO_2 buildup and the ultimately unstoppable dwindling of petroleum will compel successfully midwifing an alternative that thus far is only viable as an embryo on the testbed.

FACTORY AUTOMATION, ROBOTICS

German SMEs Reluctance To Use Robots Noted

93WS0172A Duesseldorf HANDELSBLATT in German 9 Dec 92 p 31

[Article by Burkhard Boendel: "Medium-Size Enterprises Mostly Still Have a Lot of Catching Up to Do"]

[Text] HANDELSBLATT, TL, 8 Dec 1992—There is only limited use of flexible automation with robots in medium-size enterprises. But under pressure to streamline even smaller companies will have to contend with the technology. Better acquisition costs and improved user friendliness will help that.

There are no official statistics shedding light on the connection between size of enterprise and degree of automation. The unanimous opinion of the experts, however, is that SMEs still have adequate potential for the use of robots. Accordingly, Dr. Heinz Muno, Managing Director of the Assembly-Manipulation-Industrial Robots [MHI] professional association, in the "German Federation of Mechanical Engineering and Plant Construction [VDMA]," believes that "instinctively, the use is occurring primarily in the large companies."

Japanese Remain Targeted on Robot Technology

The assessment by Michael Knaf, sales manager for Fanuc Robotics Deutschland, is similar: "There could be considerably greater use of robots in SMEs." In its latest issue the technical journal "Roboter" has tried to cast some light on this darkness through a readers' survey. Even if the results are not representative, the figures do highlight the present situation. Ninety-five percent of 290 companies using robots were typical medium-size ones with fewer than 1000 workers. Yet the 5 percent of large enterprises—16 to be exact—accounted for nearly 70 percent of the available manipulation, assembly or welding automated equipment.

The reasons for medium-size companies' caution are complex. The most important reasons that might be mentioned are allegedly excessive investment costs, high installation outlay, need for skilled personnel, programming outlay and the safety regulations to be observed.

Still, it is mostly a skepticism regarding automation that has not yet been overcome that hampers an impartial consideration of it.

If, according to data from the Fraunhofer Institute for Production Technology and Automation [IPA] in Stuttgart, Japan in 1991, with the use of more than 320,000 robots, had well over 10 times the number existing in Germany, then, according to IPA professor Rolf D. Schraft, the fact is "that we here are prattling about automation and the Japanese are doing something with it." Even Fanuc sales manager Knaf complains that "industrial robots are still viewed as 'job killers'." Overlooked in this regard is the fact that flexible automation using industrial robots helps any firm to lower production costs.

Firms, such as Kaup GmbH from Aschaffenburg, verify that this is not some pipe-dream of a robot manufacturer. That medium-size firm progressively automated and last year earned DM60 billion, having 335 employees.

The manufacturer of ancillary equipment for forklifts, who has to service his customers 'just-in-time' with one-week delivery times, acquired its first two welding robots in 1988. "Initially we went into it cautiously," recollects owner Otmar Kaup. The tasks assigned were simple to understand. The robots at first had relatively simple tasks to perform. In handling for welding, the workpieces were simply rotated. Kaup at first omitted more complicated tilting processes.

But it very quickly became apparent that the robots were as productive as five or six hand welders. "And that with better and more uniform quality," adds Kaup. Additionally automation furnished him with increased capacity enabling the company in only a single year to expand by more than 30 percent. "If we had done that in the conventional way, a new bay and more workforce would have been needed." According to Kaup that would have taken at least two years.

Chance to Reduce Production Costs

But above all, Kaup at present is competitive only with the help of flexible automation. The company would no longer be competitive against suppliers from lower wage countries without the increased productivity and simultaneous guarantee of uniform quality reports the owner. Kaup realizes that "for us the use of robots is now a matter of viability."

It is up to the individual to decide to what extent this example can be transferred to other medium-size companies. But this much is evident: even a robot offers no panacea for problems from high unit costs. Automating with a crowbar is not the way to go. It is not enough simply to purchase a couple of robots hoping this might suffice to cut costs.

Meanwhile a lot has happened with robots to simplify their operation. The best example of this is the new "RV6" flexible-arm robot from Reis, presented to the public a few days ago. The device with its many improvements belies all popular prejudices. Already the reduction in parts and components and their service-friendly grouping at the robot itself is leading to lower outlay for maintenance that then can partly be performed by the workers on site.

Above all, Reis has succeeded in so simplifying robot control and programming that not only has program updating and its associated expensive machine time practically entirely disappeared. But after a crash the robot is able to reset itself just by accessing four reference points—a matter of minutes, when earlier sometimes hours were spent re-"teaching" the robot.

Control has also been definitely simplified through input masks, for example, for welding applications. The on-site worker need only still enter parameters such as gauge number, length, width or position. The robot itself computes the appropriate procedural program while other jobs are still running. Hence the robot functions economically already from job lot "one." Reis has calculated that annual operating costs of an operationally-ready robot welding system with the RV6 still only approximately DM35,000.

Increased Use of Robots in German Auto Industry

93WS0172B Duesseldorf HANDELSBLATT in German 9 Dec 92 p 31

[Article by Stefan Schlott: "Lean Structures Lead to New Use Strategies"]

[Text] HANDELSBLATT, TL, 8 Dec 1992—With the introduction barely two decades ago of the first welding robots in bodywork engineering, the steel omnipotents launched an unstoppable triumphal march through the automobile industry. The body shop and the paint shop especially are no longer conceivable without industrial robots.

Technical engineer Gerhard Wiedemann, deputy managing director of Kuka Scweissanlagen + Roboter GmbH, Augsburg, in charge of transfer lines and assembly equipment, labels the widespread contention that lean production would signal the end of automation an "erroneous view." The nimble Swabian is not alone on this. A good part of Europe's robot suppliers is rather calmly awaiting the automobile industry's efforts at lean structures.

Simply a glance at the Mercedes-Benz AG inventory list shows the rapid penetration of all sectors: in 1982 only 17 robots could be found, last October they totaled 1602. Of those, 803 were in the Sindelfingen parent plant alone. By 1994 the inventory will rise to 1065 according to technical engineer Helmut Rapp, materials processing manager in Sindelfingen.

Robots—Often the Cheaper Solution

Equipment engineers have recognized that it is often cheaper to use a six-axle robot instead of constructing a special piece of equipment to transport a workpiece from A to B, rotating it in the process. According to Rapp: "There is often no longer any doubt about that from an economical viewpoint."

Additionally, further technical developments in the mechanical, electronic and data technology for industrial robots also are making their use more and more reasonably priced. Like the celebrated "sow that lays eggs, gives milk and provides wool," they had to be universally usable up till now. This often raised the cost of functional capabilities, mostly control technology, that remain unexploited for the entire life of the robot. This requirement is growing weaker and weaker in line with the new austerity in equipment engineering conveyed in lean production.

Further Developments Make Use More Attractive

According to Helmut Rapp, the requirement for robots used exclusively in body work to have functional assembly capabilities will increasingly be done away with. The bottom line: in a recently developed 32-bit control system, some control features were dropped on the basis of close consultations between automobile manufacturers and robot producers, resulting in savings of 20 percent.

Neither is the surface technology sector conceivable any longer without paint robots. In the small niche market, however, the situation looks somewhat different. Even large orders here seldom ever reach double-digit figures for the items. Nevertheless, paint manufacturers, who, like Herberts Gmbh, Wuppertal, are increasingly deeply involved in application technologies, are expecting in future years "technical quantum leaps in automation and robot technology" for their sector.

Peter Minko of Herberts' materials processing unit, cites as the reason, based on an evaluation of trends expressed by five German automobile manufacturers, their demand for automation with the highest possible availability. For the future also this will mean smart robot systems.

LASERS, SENSORS, OPTICS

Eastern German Firm Develops High-Resolution Camera

93WS0078C Frankfurt/Main FRANKFURTER ALLGEMEINE in German 28 Oct 92 p N2

[Article by Gunter Paul: "Precise Measurements From a Distance; High-Resolution Camera/Jena Engineer Uwe Richter"]

[Text] Ever higher requirements are being placed on precision in the manufacture of various kinds of components—of chassis in the automobile industry, for example. One can check with calipers, probes and other devices whether the required precision has been attained in each case. Uwe Richter, who now works at the RJM (Rheinmetall Jenoptik Optical Metrology) company founded at the beginning of the year, has developed with a team of researchers a high-resolution CCD camera that is the only one of its kind in the world, with which non-contact measurements can be made.

The man from Jena had already as a student had the desire to do research in a scientifically attractive environment. Above all the special research center of the Carl Zeiss Jena combine, which was built in Jena-Goeschwitz from 1980 to 1986, attracted him. A concentration, unique for the GDR, of the most different fields of science formed there. In Goeschwitz teams of young researchers could develop new technologies without being financially limited. After studying automation at Dresden Technical University, Richter was employed at the special research center and studied infrared technology there. However, this field was terminated in the spring of 1987 under the highest orders. Six months later the entire team was assigned to a semiconductor department in which the quality of masks for the manufacture of extra-large-scale integrated circuits at the 4-megabit chip level was controlled.

Instruments having high optical resolution were needed for this task. Big requirements were also placed on the illumination and the sensors for error detection. The structures—chromium films on glass—have diameters of smaller than one micrometer and are quite unusable if they show a flaw measuring one-tenth of a micrometer. At that time researchers had many ideas as to how the precision could be increased through control. An obvious idea was to use a CCD sensor for this, that can be moved by less than the so-called pixel dimension (the dimension of a picture element in the sensor). By means of this technique a more precise computer image could be reconstructed, in which certain algorithms (computational processes) would reveal the flaws.

This microscan technique has been studied since the middle of the seventies in the United States, Japan and the Soviet Union for various applications. As the first CCD planar sensors appeared, research work in the laboratory also followed. It was a matter above all of replacing the usual tube system in television by CCD equipment. The 200 x 200 pixels of the first planar sensors were not sufficient for the purpose. Toshiba in Japan has implemented the microscan technique for television engineering, but the system is not available. The only microscan system ready for the market—for taking pictures of color art work—was introduced in 1989 by the German Kontron company. However, this makes do with far lower precision requirements.

Richter had to look around for new assignments when the development of instruments for flaw detection was discontinued for financial reasons in the summer of 1990 at Jenoptik Carl Zeiss Jena—the former combine. Together with Gunter Gittler he had the idea of developing an extra-high-resolution CCD metrological

camera that would be based on the microscan principle. High optical and mechanical precision were important here. Meanwhile the scientists were extremely knowledgeable in this field. The development goal was to replace the classical measuring techniques—that although extremely precise, they are however very expensive because of the mechanics required—with a non-contact-functioning system.

At the time CCD sensors with 750 pixels horizontally and 580 pixels vertically were available inexpensively. In addition, Kodak had expensive special-purpose sensors with 1300 x 1100 pixels and not commercially available sensors with 2000 x 2000 pixels that are used only in a camera made by the American Photometrics company. They wanted to surpass even this top figure for the metrological camera. Richter and his team developed on the basis of a CCD sensor with 750 x 580 pixels and the microscan technique an instrument that produces images with 4500 x 3500 pixels.

Two prerequisites above all had to be fulfilled for the development. Lenses were needed that, with high resolution, have especially low geometric distortion, and a microscanner with which each position can be approached consistently. The lenses presently available for the instrument have a maximum distortion error of 0.05 percent over the entire image area. The lenses normally used in metrology show an error of 1 percent. The lens's residual error is known. It can be taken into account computationally when the image is being constructed in the computer.

The Jena microscanner can be moved in 1.8-micrometer steps. But individual positions can be determined substantially more precisely—to 0.2 micrometer. The metrological camera could not have been implemented without this high quality of the lenses and microscanner. Richter is of the opinion that the instrument will have no competition for the foreseeable future for extra-high-resolution measurements.

There is a wide range of applications for the camera. It is especially well suited for the measurement of flat parts—the metal substrate of chips, for example. But there is also interest in the automobile industry—in the manufacture of chassis and bodies, for example. In addition, Richter has in mind the measurement of stamped metal parts in precision machine building.

Normally one can analyze with the camera in 200-micrometer segments a rod, for example, that is a meter long. This detailed resolution produced by the number of pixels can, however, increase tenfold in many cases. For example, an image shows no abrupt drop at the edges, but a smooth transition to the surroundings that can be represented according to a mathematical law. They have formed such algorithms in Jena and entered them into the camera's "memory." They help to determine the position of edges far more precisely than would be possible by means of the simple camera geometry.

MICROELECTRONICS

German X-Ray Lithography Noted

93WS0092A Duesseldorf HANDELSBLATT in German 4 Nov 92 p 30

[Article by Achim Scharf: "Finer Patterns only Possible with Roentgen Lithography"]

[Text] HANDELSBLATT - TL, 3 Nov 1992—Since developmental costs for a new chip generation increase 50 percent every three years, and production investments even rise as high as 80 percent, international cooperation has become a necessity. This is especially true with respect to memory chips.

By January 1990, IBM and Siemens had already concluded an agreement on the joint development of the 64-megabit DRAM [Dynamic Random Access Memory]. The first laboratory prototypes were displayed late last year. By virtue of its precisely 67,108,864 bits, the 64-megabit DRAM can store more than 3,000 pages of text. Some 140 million transistors have been integrated on a silicon surface the size of a thumb nail. The so-called pattern dimensions (width of a transistor gate) are 0.4 µm.

IBM's newly built Advanced Semiconductor Technology Center (ASTC) in East Fishkill, N.Y., is being used as the pilot line for the 64-megabit DRAM. The only privately owned synchrotron storage ring in the United States for X-ray lithography is currently also to be found in the ASTC. About a half a billion dollars have been invested in the ASTC since construction was begun in 1986.

High Investments Required

Since even the slightest vibrations may adversely affect the highly sensitive lithographic systems, the greatest possible attention is given to making them vibration free. Thus, the lithographic system is designed to stand on a 8,000-t reinforced concrete plate, which, in turn, is supported by concrete columns residing on a 1.20-m-thick foundation.

The so-called lithography is also the key technology for achieving the highest integration densities and/or the most compact pattern dimensions.

In photolithography as in conventional methods, normal light beams are used to write—as with an extremely sharp pencil—ever smaller circuit geometries on the silicon wafer. Meanwhile, however, the spacings on the chip have become as small as the approximately 0.8 µm light wavelengths employed, namely, about a hundredth of the thickness of a hair. The problem is something like trying to draw a thin line with a broad brush.

Photolithography Already Beyond the 16-Megabit Limit

Because this development was foreseen early on, ways of circumventing it have been sought for years. Among these, X-ray lithography occupied the first place among

the possible alternative solutions. X-rays use a substantially shorter wavelength than light—one nanometer versus the several hundred nanometers in the conventional processes.

Meanwhile, industry is firmly convinced that photolithography will be useful in the mass production of highly integrated chips at least until the turn of the century. The now developed 64-megabit DRAM, which was developed on this basis, has demonstrated this. Previously, the 16-megabit DRAM was considered the limit of optical lithography. The so-called phase shift has contributed to this development, as do shorter light wavelengths (e.g., the ultraviolet light generated by lasers), as well as improvements in the reduction lenses, and the light-sensitive chemicals. These developments should permit circuits with spacings of 0.2 μm and less to be produced, while just 10 years ago the "limit of light" had been assumed to be 0.8 μm.

Expenditures involved in the elimination of conventional processes are always costly. If, for example, an expenditure of $300 million had to be laid out for an optical lithography line, then an X-ray design would probably come to $500 million. This cost consideration does not, however, prevent either Japanese nor American nor European companies from pursuing the path of X-ray lithography. Optical lithography, characterized by diminishing spacings on the chip, is also becoming increasingly expensive. Probably, at some specific point in time, there will be no reasonable way to ignore X-rays.

The Smaller the Spacings, the More Expensive the Process

For years now the German Federal Ministry of Research has supported extensive preliminary work involving the use of X-rays in the submicrometer range—first in large installations like Desy in Hamburg or Bessy in Berlin; then in more practical smaller facilities like Cosy (Compact Storage Ring for Synchrotron Radiation) likewise in Berlin. The industry already offers suitable X-ray steppers for these X-ray generators.

An X-ray stepper, which is designed for combination with Cosy and which offers considerable performance advantages over light optical steppers, has already been developed by the German Suess Company. If an optical stepper has to be operated for structures of 0.3 μm at its performance limit, an X-ray stepper has considerable reserve, especially in contrast.

But, in the opinion of insiders, it is not just the advantages of high resolution that will provide the breakthrough for X-ray lithography. Its extremely high process safety record will also be decisive. The technically simple process with diffraction-free, parallel X-radiation permits high tolerances in some process parameters. The incident radiation energy has only a slight effect on the imaged line width since the energy distribution under a mask window on the silicon wafer runs at right angles and there is practically no scattering. Further advantages lie in the high depth of definition, e.g., 20 μm for patterns of 0.2 μm and the fact that the image is independent of the surface of the wafer. Furthermore, there are no reflections or standing waves that could lead to interference.

New Process Offers High Process Safety

The international competition is not asleep however. The German lead in this small industrial segment is gradually being whittled away. In Japan, for example, more than ten synchrotron installations are under construction, while Hitachi and Toshiba are producing compact rings. In the United States, besides IBM in the ASTC, Motorola is involved in X-ray lithography. Texas Instruments, too, is working on X-ray lithography on the University of Wisconsin's synchrotron.

The Siemens and IBM 64-megabit DRAM, designed for the mid 1990s, is still produced by optical lithography. But for the next generation, at the turn of the century, X-lithography will become the production reality. IBM, Siemens, and Toshiba want to develop this chip, with line widths of 0.25 μm, jointly.

European Research in Biological Material for Chips

93WS0092B Duesseldorf HANDELSBLATT in German 4 Nov 92 p 30

[Article by Wolfgang Asche: "Organic Molecules Used as Circuit Element"]

[Text] HANDELSBLATT - TL, 3 Nov 1992—Dr. Johannes Kohl, board spokesman of Wacker Chemistry in Munich, the speaker of precisely that firm which has been among the leading producers of crystalline silicon for a long time, recently perplexed the scientific community: "Our research is intensively concerned with the fermentative production of a light-sensitive pigment bacteriorhodopsin for the development of biochips."

Has silicon lost its position as the main substance for chips, with their tightly packed circuits? Dr. Joel S. Miller, involved in solid-state research at DuPont, a U.S. chemical multi, gives a simple answer: "The silicon technology of inorganic substances is reaching the natural limits established by miniaturization. The use of organic molecules as circuit elements provides a solution for the further miniaturization of chips."

"Molecular electronics" already exists in nature as, for example, in the photosynthesis of plants, where light excites molecules like chlorophyll, releases electrons, and sets chemical reactions in motion. Wacker's bacteriorhodopsin (BR) also originates from natural sources. It was discovered in the outer cover of halobacteria living in hot salt basins, where it absorbs light energy, releases a positive elementary charge, and sets chemical reactions in motion. It can be excited by yellow, red, and green light, and is returned from the excited state back to the original state by blue light. This is the starting point for its application in biochips. Light of the appropriate color

permits alternate switching between two states. "In-out" or "yes-no" type data can be stored. BR foils developed by Wacker biotechnically with the aid of genetically altered microorganisms are especially suited for holographic pattern storage.

Holography, the depiction of the spatial properties of an object with laser light, reaches the highest values of packing density. BR requires no developmental process like film treated with silver chemicals, such as can be found in the holograms in EC charts. Another application of holography with BR are interferometric measurement processes in which the vibrations from a measurement probe are superimposed multidimensionally.

ICI Imagedate of Great Britain has developed a more conventional dye for data storage. An infrared laser is used to excite a dye fixed on a polyester foil with a bedded polymer layer.

In the process, heat, which creates a "dimple" in the plastic, is generated. The dimple pattern stores the originally binary coded information. The storage of data from an earth reconnaissance satellite in Canada is named as the first application. An 880-mm-long and 35-mm-wide tape of material can store one terabyte (10^{12}). In one EC project, the Krupp Research Institute in Essen tested small tags made from digital paper as an identification on machine tools in the automatic plant. The "holotags" had stored the data holographically. Its advantage was seen to be in that they could be read optically without being touched and without electromagnetic field disturbances and were even readable when soiled or damaged. Unlike BR storage the image paper/holotag is only recordable once and then is only legible (WORM principle).

Numerous other molecular electronic concepts are in the research stage. Recently, Professor Doctor Heinz Langhals of Munich University exhibited a storage based on the fluorescent dye diketopyrrolopyrrol. Heating to 195° C by means of a laser beam (writing) produces a yellow crystal form, which fluoresces intensely, i.e., emits in response to light excitation. Heating to 230° C destroys this crystal modification, and the information is deleted. During cooling a pale yellow modification that is almost no longer fluorescing develops. No chemical bonds are altered. Write/read/delete cycles can often be repeated.

Besides photochromic materials, which change state through the effect of light, there are also electrochromic materials, which react to in- and outgoing electrons. In this regard, Professor Marco Paoli in Rome is researching the very promising polypyrrol dodecylsulfate. Phthalocyanines are the great hope for Professor Doctor Michael Hanack of Tuebingen University as well as for Professor Jack Silver of Essex University. The molecular skeleton of phthalocyanine is, as a chromophoric group, at times coordinated with specific metals, known from the blood pigment and the chlorophyll of the plants.

"Crystal engineering," as Miller calls the custom tailoring of suitable chips for the micro- or, better, the nanoelectronics of the future, appears to be blossoming out as competition for silicon technology. Miller dampens the euphoria by noting that "the question of long-term stability still remains." Silicon-based circuit elements and storages will still be able to exhibit their operability for several more years in any case.

TELECOMMUNICATIONS

Europe Videophone Project Set for 1995

93WS0125A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 23 Oct 92 p 8

["Will Videophones Become a Billion Dollar World Market as Early as 1995?"]

[Text] bnf. FRANKFURT—Videotelephony, the new communications medium is to be tested on an international basis within the framework of the European Video Telephony Project. The first such official international videophone linkup in Germany was conducted in Dresden at the Telekom Forum'92 by Helmut Ricke, the head of Telekom, who spoke with the president of British Telecom, Iain Vallance, who was in London. During a videophone session, besides the voices, a color moving picture is also transmitted over the ISDN net. A 60-minute session costs twice the normal telephone fee (for each of the two ISDN channels), amounting therefore to a total of 138 German marks [DM]. A DM74 monthly charge must also be paid for the base connection.

A video telephone consists of a monitor with camera, an ISDN telephone as the central control unit, and an encoding device. Analog image and audio signals are encoded or decoded in the heart of each unit, called the Codec. To transmit in ISDN, the data set of the video signal has to be substantially reduced. Unlike the television standard, in the case of video telephony only 10 images instead of 25 are transmitted per second. Images and image parts must therefore be stored in the video phone and then, following a computational procedure, reconstructed again into a video image.

Presently, Telekom offers three ISDN telephones made by SEL, PKI, and AEG. In other European countries, in addition to the aforementioned, units produced by British Telecom, Matra, SAT, Aethra, and Tandberg are also in use. By the time of the scheduled launching of mass marketing of video telephones in 1995, the price per unit is expected to drop from the current DM43,890 to less than DM5,000. By the end of the decade, Telekom anticipates a price level comparable to today's color TV sets.

In 1991 the six partners in the European Videotelephony Project—Germany, Norway, Great Britain, the Netherlands, France, and Italy—had already agreed that the videotelephony service would be introduced in Europe

by 1995. The project calls for the implementation of a single standard for videotelephony and support for the broad marketing of video phones.

In the practice trials, all available instruments as well as the performance capability of the connections in each of the participating countries will be tested. The current partners in the project are attempting to expand the use of the videotelephony service to other European countries. Currently, talks are being held with Belgium, Portugal, Sweden, and Switzerland about participation in the European Videotelephony Project. In addition, the participating telecommunications companies want to test the technical feasibility of overseas videotelephony linkups, particularly with Japan and the United States.

According to the terms of the project, each of the six participating countries is to have at least 50 videophones connected to ISDN by mid 1993. Telekom has announced that this goal will be reached in Germany in a few weeks. In the pilot program Telekom is agreeing to separate promotion arrangements with its customers. The goal is to test out the service and the equipment as well as to develop new applications. For his participation, the individual participant receives compensation of about DM500 per month.

Telekom expects a breakthrough for videotelephony in 1995. According to a study produced by equipment manufacturer Philips Kommunikations Industrie AG (PKI), Nuremberg, there should be roughly 150,000 videophones in operation in Europe by that time. Telekom estimates further that, of these, Germany will have between 30,000 and 40,000 in ISDN. A world video communications market volume of more than a billion dollars is predicted for 1995. The yearly rates of increase could reach between 20 and 30 percent.

CCITT recommendation H.262, which describes the encoding and decoding algorithms for moving pictures, is the standard of central importance for multinational video telephony. The Common Intermediate Format (CIF), derived from the CCIR 601 television standard, was taken for the screen parameters. The standard H.211 defines the synchronism to be imparted between the two B-channels in ISDN for the transmission of audio and images. Establishing and breaking off connections between two videophones has been unified by the H.242 protocol. The official synchronous exchange of control information is determined within the H.221 master structure in standard H.320. Moreover, a single D-channel protocol is to be adopted in 1993, by means of which German videophones will also be operable in other countries. In addition, the development and implementation of a standard for videophone conference circuits has been planned.

To operate a videophone, connection to ISDN via a S_o interface is required. In the case of a branch extension, access can be effected via a primary multiplex connection. For the simultaneous transmission of audio and color moving pictures, the two ISDN channels, each having 64 kilobits per second, are used. ISDN is to be available everywhere in the former West German States by late 1993 and in the former GDR States by late 1995.

According to Telekom, about 90 percent of their customers could already obtain an ISDN connection if desired. In the other five participating countries of the European Videotelephony Project, conditions for the expansion of ISDN are comparable to those in Germany. Telekom now offers two forms of picture communication, the videophone service in ISDN and the video conference in the Wide Band Switch Exchange Net (VBN). The video conference service, which has been available since 1989, produces a high picture quality, comparable to television.

VBN uses a fiberglass net that permits transmission rates of 140 megabits. Connections already exist in over 80 cities. The more than 400 Telekom video conference customers have a monthly volume of traffic of over 5,000 hours. The high transmission quality of a video conference is also associated with high costs. The transmissions costs alone run to roughly DM600 an hour. However, since the videophone—as the favorable cost alternative to the video conference can only manage limited demands in business traffic, Telekom is working to develop a video conference service with transmission rates of 384 kilobits a second and two megabit a second. At "somewhat higher" costs, demonstrably higher quality pictures than currently available in the ISDN video telephony are said to be attainable.

Germany: More Telecommunications Research Needed

93WS0125B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 9 Nov 92 p 10

["More Research for Telecooperation"]

[Text] TN. Frankfurt—In connection with the decision to make Berlin the capital, the federal government wants to devote more attention to telecooperation projects because communications between the widely dispersed administrative offices in the country must remain efficient and be constantly improved. Both the Ministry of the Interior as well as the Ministry of Research are working on the problem. To achieve the requisite information-technical cooperation, the German Bundestag has intervened and issued guidelines. The trend toward decentralized solutions of organizational, cooperative, or information-logistic functions in cooperative undertakings between separate, individuals or offices presents a great challenge for research, but also for the development of highly advanced infrastructures.

Only with the aid of innovative communications and information technologies will it be possible to achieve an operable and efficient division of labor between work units that are separated by space and time. Despite their being separated, all participating workers must be in a position to carry out their work cooperatively without

limitations. Moreover, they will be offered comprehensive system-engineering support in their cooperative functions. The further development of telecooperation should result in a qualitative leap in cooperation.

As further reported, currently available technologies are far from adequate. An innovation process has to be introduced, in which German industry could also take a leading role. A comprehensive telecooperation program is to be prepared in line with the initiatives of the Ministry of Research for Berlin-Bonn information-technology cooperation. It is to be designed as an integrative project, in which science and industry will closely cooperate. At this juncture, the Society for Mathematics and Data Processing will introduce Project Polikom.

Essentially, Project Polikom involves three fields: communications technology, cooperation, and coordination. *Communications technology* must facilitate the rapid and reliable exchange of multimedia information in the most natural manner possible and in various ways (via communications lines, by radio, narrow or wide band transmissions). Currently existing individual solutions are to be replaced by complex integration technologies based on a powerful communications net.

Cooperation requires user-friendly systems for joint work on the same document and easy access to common multimedia and distributed information sources. The basic tasks of research are aimed at the development of transparent, open, and compatible systems with respect to application.

A cooperative division of labor is the prerequisite for *coordination.* As an independent assistance function in information-technology systems, coordination support will be increasingly complex in measure as the cooperating units become more comprehensive and the distribution of tasks widens in space and time. Advances in the field of computer-based cooperative work would have to create the prerequisites for this. In order for the system to be accepted by the workers, it is essential that system behavior be adapted to human behavior and that support in joint projects be constantly improved.

ISDN Network Begins Operating in Italy

93WS0155A Milan SISTEMI DI TELECOMUNICAZIONI in Italian Sep 92 pp 8-17

[Article by Stefano Martini, of Italtel SIT, Milan: "ISDN: A Network for Which Services?"]

[Text] Finally, in Italy as well, indeed as of 1 June 1992, the dream of many users of telecommunications services and applications of the information-processing type has come true: As of that date, SIP [Italian State-Owned Telephone Company] put into service its ISDN [Integrated-Services Digital Network], which enables the integrating of information of diverse natures, such as voice, data, and images, on one and the same physical carrier (which coincides with the subscriber's normal telephone pair).

The genesis of this important sector of the telecommunications world has been rather long and arduous.

In 1984, at ISS84 [International Switching Symposium '84] in Florence, SIP, CSELT [Turin Telecommunications Study Center], and ITALTEL [Italian Telecommunications Company] proposed an experimental mini-network.

The Florence Fair, the CSELT's head office in Turin, and that of ITALTEL at Castelletto di Settimo Milanese, were interconnected by way of experimental equipment developed through research by ITALTEL together with CSELT.

This 1984 start was followed by a lengthy phase during which the technical specifications were drawn up for the implementation of the ISDN and the deployment of a pilot network interconnecting the principal Italian cities.

The specifications phase underwent many revisions, owing also to the parallel work being done by the ETSI [European Telecommunication Standards Institute] and to the natural technological evolution, which from time to time rendered obsolete some of the technical choices made during that phase.

In 1990, the round of specification writing was completed, and the implementation phase was finally begun.

During 1991, Italtel and SIP's other two "major suppliers" made available for deployment the hardware and the release software that constitute today's ISDN system.

The SIP ISDN today covers 12 Italian cities and is interconnected, at the national and international levels, with the analog telephone network, the ITAPAC packet-switching network, and the RFD voice and data network.

The basic concept of the ISDN is the integration of standard telephone service with the availability, directly to the subscriber's premises, of a two-channel (two B-channels) transmission capability at 64 Kbits/sec (termed a basic access).

The ISDN basic access enables use, on the same line, of one channel for telephone service, and, simultaneously, of the other channel for a data call, or any other combination of the two.

Thus able to use the same pair to which his old analog telephone was connected, the world of multimedia—the capability of receiving voice, data, and images directly on a single terminal that can be a standard PC [personal computer] equipped with an ISDN interface, and via a single telephone subscriber line—is opened to the subscriber on a geographical scale.

Primary accesses [PRA] consisting of 30 B-channels at 64 Kbits/sec are used to connect PABXs to the ISDN, and constitute the other means of access available to users.

But SIP's plans certainly do not end with coverage of the aforementioned 12 cities.

During 1994, ISDN accesses will gradually be made available throughout the national territory.

The degree of ubiquitousness of the service is tied to the massive investments the operating company plans to make in the modernization of our country's telecommunications infrastructures, the intent of which is to align Italy with the countries offering the best worldwide telecommunications services.

But as of today, what is it possible to do, given the technology the SIP ISDN now makes available?

To answer this question, let us simulate a tour of Italtel's ISDN Democenter in Milan.

The center was set up in close cooperation with leading firms in the computerization sector, such as DEC, HP, IBM, and Toshiba, specifically to test applications and telecommunications services intended to respond to the manifest needs of the business user. It is offered as a point of reference—the only one in Italy offering the same range of services—for businesses wishing to broaden their horizons and enter the world of multimedia.

Obviously, the ISDN provides telephone service. Italtel Telematica offers a number of telephone sets ranging from the new digital type telephone equipped with a display—enabling it to display information such as the telephone number of the caller (before answering the incoming call), the progression of the pulse counter that meters the chargeable duration of the call, hence the charge being incurred as the conversation progresses, the arrival of a second incoming call which can be taken by putting the first call on hold, answering the second call, switching both to a conference mode if desired, and so on—to the new line of ISDN PABXs offering sophisticated voice/data capabilities for modern office-automation applications.

Specific equipment for data applications is provided by the family of adapters for the more common interfaces (X.21, V.35, X.21bis, V.24, a/b, etc). Italtel also offers the new G4 Faxes, new generation fax machines enabling an A4 page of text to be transmitted in about 6 seconds, and a high-resolution (300 dots per inch) page of text and images in about 30 seconds.

But would it not be nice to be able to telephone a client and at the same time access an image data bank? Well, it not only would be nice; it is also possible. Italtel and IBM have developed an application designed to fulfill the needs of the publishing world and of news and advertising agencies.

Simulated here is an installation at the head office of a news agency, consisting of a basic ISDN access, an ISDN telephone, and a type RISC 6000 workstation.

The agency offers its clients the capability of accessing an electronic archive of images, directly from their premises, via the ISDN system.

The photos, digitized and compressed, are transmitted to the client using one of the two 64-Kbits/sec channels, the other remaining available for, say, a telephone conversation.

The average time of transmission, hence the duration of the ISDN connection for which the subscriber is billed, is about 7 seconds.

Photographs for daily newspapers, weeklies, and advertising agencies can thus be remotely selected and, once received, used, in digital form, with an electronic formatting station where texts and photographs are assembled for the definitive formatting of the article.

Other applications involving centralized archives of images are, for example: automation of cadastral offices; distribution of images of the national artistic heritage, from the national photographic archives, where they have been centralized, to independent travel agencies and national tourist offices; etc.

The theme of "telelavoro" ["remote employment"], addressed recently by European Community Directorate XIIIF in its PACE '92 [Perspectives on Advanced Communications for Europe '92] report, is one that will characterize the telecommunications and labor scenario in coming years.

Generally speaking, this type of application will enable persons to work from home, or from suitably equipped telematics sites, in activities that today require the use of instruments and/or facilities available only on the firm's premises.

An approach of this type will enable the implementation of policies specific to decentralized areas, handicapped persons, etc.

With this in mind, IBM and Italtel have for some time been testing a "remote employment" setup, consisting of a standard PC, an ISDN interface (a card that can be inserted in a slot of the PC itself), and a basic ISDN access.

The PC becomes the instrument capable of managing text, data, and images, and of sharing the contents, through a simple command, with another PC connected in an area network, via the SIP ISDN.

All operations, such as text modifications, changes made to the data and graphics of an electronic page, etc, are updated in the remote PC in real time, enabling complete interactivity between the two subscribers. This interactivity opens new horizons and new perspectives on the organization of labor in industries and service firms. Italtel and Digital together have tested ways in which local area networks [LANs] of the Ethernet type can be equipped with a "port" to the geographically distributed ISDN world. Italtel's computer network,

which today supports 2700 terminals, 330 printers, with 350 MIPS [million instructions per second], 163G magnetic bytes, and 18G optical bytes, uses as a server a MicroVax system equipped with ISDN interfaces. In this way, with a simple ISDN telephone connection, the entire company's resources and computing power become available nationwide.

Italtel and Hewlett-Packard have pressed their collaboration in the ISDN field beyond the normal applications relating to office automation and image management, and have addressed the fields of supervision, control, and management of networks, and of remote radiology and medical applications in general. In the first case, hence in a multivendor environment, the monitoring of TCP/IP LANs is made possible by the ISDN's digital interconnection capability on a geographical scale.

From an HP workstation, a remote LAN can be reached via an ISDN-switched connection, and a control application launched that enables sophisticated management functions, such as remote login, control of loading of the remote CPU, statistics, and testing of equipment, etc.

In the biomedical field, where, in order to avoid loss of information that may be relevant from a diagnostic standpoint, images cannot be compressed, it is essential to have available sufficient bandwidth to enable optimization of transmission times.

The ISDN router, with one to three basic accesses, enables the making of up to six simultaneous calls (two per access), which "travel" through the network as separate routings at 64 Kbits/sec, and are then paralleled at the router level. In this manner, a gross bandwidth of 384 Kbits/sec is obtained.

The information to be transmitted, attached to the patient's personal data chart, varies according to the type of examination. An X-ray examination, for example, involves between two and five images; and a CAT scan, from 10 to 20 "views." The information to be transmitted will thus total around 5 to 15 megabytes.

The results obtained in the ISDN Democenter, with respect to the transmission times of medical images, are better than merely acceptable. The first image arrives in about 10 seconds and, while the doctor studies it, the succeeding one is loaded, and so on. When all have been transmitted, they remain available locally for subsequent consultation as well. Interactive operation between two stations is also provided for, enabling direct "consultations," for example, between a USSL [Local Health Service Unit] and an Italian or international specialist center.

The last application in our "tour" has to do with videocommunication. It is undoubtedly the one that makes most advantageous use of the ISDN access. It engages both the B-channels simultaneously, thus using 128 Kbits/sec to transmit full-motion video of excellent quality, thanks to compression algorithms and to redundancy reduction techniques conforming to H.261 international standards.

Italtel's videocommunication offerings are: a setup for personal videotelephony that resembles a PC and provides all the functions of one, with the capability of switching instantaneously to video services (actually, the setup is equipped with a built-in TV camera); a videoconferencing setup that can be used for meetings of four to six persons, who can thus avoid lengthy travel for "routine" meetings (the setup is completely self-contained, with a 26-inch monitor, a swivel-mounted television camera with zoom, positioned by an infrared remote control unit that is also the system's control console); a videomatic switching center that centralizes the sensitive facilities (video codec H.261) on which the ISDN lines are terminated.

The switching center provides: local switching among several full-bandwidth videomatic stations, with multivideoconferencing capability between individual conferees or in a multiscreen configuration; widespread broadcast of centralized video sources (video tapes and or video disks) for dissemination and interactive type services, and, of course, narrow-band (128 Kbits/sec) interconnections with other active video setups within the ISDN or RFD environments.

Italtel system capabilities enable use of videocommunication's broader spectrum of interactivity, ranging from full-motion video to the transmission of fixed images, for working meetings, including meetings between Milan and New York.

This ends our "tour" of the ISDN Democenter. The overview it offers of the SIP ISDN's capabilities certainly does not cover all the demands yet to be expressed by its users. It is nevertheless significant, we think, and, moreover, almost all the applications viewed will be tested directly by the users over the next several months.

One of the principal "enemies" of the ISDN is the lack of a widespread end-user culture oriented toward taking advantage of the services being made available by new technologies.

Only a targeted information campaign, supported by special marketing and promotional efforts, can succeed in bringing the end-user into closer contact with the new applications in the world of telecommunications.

An example of the creating of an "ISDN culture" is represented by the text of the Italtel brochure reproduced in the box below. It contains a number of answers to questions selected from those that some 500 visitors to Italtel's ISDN Democenter (since February 1991) have most frequently asked.

[Box pp 16-17]:

The 'ISDN World': Answers to Possible User Questions

1. *The English acronym ISDN stands for...* Integrated-Services Digital Network.

2. *Can an ISDN access be had in Italy?* Yes, if the interested firm or home is located in Milan, Turin, Brescia, Genoa, Trento, Venice, Rome, Pisa, Bologna, Naples, Bari, or Palermo.

3. *In the event of installing an ISDN terminal, must the firm's or home's cabling and wiring be entirely redone?* No. Use can be made of the same telephone pairs that presently connect analog telephones to the network.

4. *When an ISDN access with the new digital telephone with display becomes available, how does one use the latter?* Exactly like a conventional telephone. The ISDN is connected both with the national telephone network, so that one can call and be called from any analog telephone, and with the international network for telephoning abroad. All one need do is dial the digits currently in use, without adding any new digits.

5. *The digital telephone and the ISDN's new services are very interesting. But what is the cost per ISDN timing pulse?* An ISDN timing pulse costs exactly the same as a conventional telephone network pulse, and the pulsing rates applied are the same as those of the conventional telephone service.

6. *What is the monthly subscription charge?* The subscription charge for a basic access (two 64-Kbits/sec channels, which is equivalent to having two separate telephone lines), is 50,000 lire(*) a month.

7. *Is there no difference in cost, then, between a telephone call and a data call on the ISDN?* Actually, the charge per timing pulse is the same, 127 lire(*), but the pulsing rate differs. For an ISDN telephone call during the peak load period, for example, a pulse is applied every 11.5 seconds, whereas for an ISDN data call during the same peak load period, a pulse is applied every 5.75 seconds.

8. *Can a PC also be connected to an ISDN access?* The PC must be equipped with an ISDN interface card, which is inserted in one of the PC's available slots. Files can thus be transferred at a speed of 64 Kbits/sec.

9. *How is a connection made to the ITAPAC packet-switching network?* By means of an ISDN access, one can access the existing packet-switching networks, as well as exchange packet-assembled data directly with other ISDN users. One need only equip the X.25 terminal with an adapter (Terminal Adapter X.25-ISDN).

10. *Can one's "old" analog equipment be used on the ISDN or must it be discarded?* Substituting it is in any case advisable, of course, but, by using a terminal adapter of the A/B type, conventional telephone, modem, and G3 fax equipment can operate on the new ISDN digital access as well.

11. *What about a private exchange?* If one wishes to take advantage of the ISDN's innovative capabilities, it must be replaced. PABXs are available with ISDN Primary Access interface (a 2-Mbits/sec line with ISDN signaling is required). Besides incorporating the most advanced supplementary services typical of PABXs, they offer ISDN services as well.

12. *What is the meaning of a G4 fax?* G4 facsimiles are machines for the transmission of documents which, given their high-resolution (300 dots per inch) and the use of a 64-Kbits/sec B-channel of the ISDN access, provide, on plain paper, by means of a laser printer, superior-quality reproduction of documents containing text and photographs, with transmission times on the order of a few seconds for a page in A4 format.

13. *Is a Group 4 fax transmission considered a telephone call or a data call?* It is considered, for all effects and purposes, a data call.

14. *What is the meaning of the term "call ID?"* It is a service unique to the ISDN, that displays the telephone number of an incoming call on the monitor screen of the called telephone.

15. *What is the purpose of a videomatic station?* The videocommunication equipment produced by Italtel makes full use of both transmitting channels of an ISDN basic access. Through the use of a redundancy reduction algorithm, compressed full-motion video of excellent quality is obtained with a bandwidth of only 128 Kbits/sec, which, combined with a graphics transmission capability, enables the holding of working meetings between sites located remotely from each other.

16. *Suppose a firm has three offices and an LAN at each office, how can it make use of the public ISDN?* There are many possibilities. There are ISDN routers that manage LAN's with multivendor environment; TCP-IP; distributed working environments on area networks can be interconnected through ISDN basic accesses (maximum of 3). When a user wants to access the facilities of the other remote LAN to exchange files, the router calls up a connection via the ISDN. This incurs only a charge for the duration of the ISDN connection.

(*)(OFFICIAL GAZETTE OF THE ITALIAN REPUBLIC, 132nd YEAR - No. 303, 28 December 1991, Decree 2 December 1991).

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